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SUMMARIES OF SOLID WASTES DEMONSTRATION: GRANT PROJECTS - 1968

Charles E. Sponagle

Environmental Control Administration
Cincinnati, Ohio

1968

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SUMMARIES

solid wastes demonstration grant projects—1968

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FOR GRANTS AWARDED DURING THE PERIOD
JULY 1, 1966–DECEMBER 31, 1967

For more information concerning the Solid Wastes Program, write to:

Chief, Solid Wastes Program
Environmental Control Administration
222 E. Central Parkway
Cincinnati, Ohio 45202

Regional Program Chief
Solid Wastes Program
Environmental Control Administration
(See inside back cover)

SUMMARIES

solid wastes demonstration grant projects—1968

FOR GRANTS AWARDED DURING THE PERIOD
JUNE 1, 1966–DECEMBER 31, 1967

CHARLES E. SPONAGLE
Sanitary Engineer Director

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service

Consumer Protection and Environmental Health Service
Environmental Control Administration
Solid Wastes Program
CINCINNATI

1968

Public Health Service Publication No. 1821

preface

THE SOLID WASTE DISPOSAL ACT OF 1965, Title II of Public Law 89-272, directed the Secretary of the Department of Health, Education, and Welfare to initiate a national research and development program for new and improved methods of proper and economic solid waste disposal, and to provide technical and financial assistance to State and local governments and interstate agencies in the planning, development, and conduct of solid waste programs.*

To carry out these directives, the Solid Wastes Program was established. Major responsibilities of the Program include, (1) conduct and support of research on the nature and scope of the solid waste problem, on methods of more safely and efficiently collecting and disposing of solid wastes, and on techniques for recovering from solid wastes potentially valuable materials and energy, (2) provision of training and financial and technical assistance to local and State agencies to survey their needs in the solid waste area, and plan for the development and staffing of programs capable of meeting both present and future requirements, and (3) encouragement and support of projects that may demonstrate new and improved methods of solid waste collection, handling, and disposal. The latter involves provision of grant support for the following types of projects:

1. A demonstration relating to the development and application of new and improved solid waste disposal methods, devices, or techniques.

2. A study and investigation of municipal or regional solid waste disposal practices, procedures, and programs, which may:
    a. provide solutions for regional or national solid waste disposal problems, or
    b. lead to a demonstration of improved disposal practices.

3. A study and investigation of a particular solid waste or solid waste disposal problem, practice or technique, the findings of which will be of significant national value.

Demonstration Grants Activities has been established within the Solid Wastes Program, to implement this responsibility. Its principal functions include: advice concerning development of new applications; technical review of new applications; continuous monitoring of funded grant projects (consisting principally of provision of technical assistance to grantees, review and evaluation of the project's progress in attaining objectives, and ensuring that appropriate Federal requirements are met); dissemination of information resulting from funded projects; and development of required administrative and fiscal procedures.

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* The Act directs the Secretary of the Department of the Interior to carry out a similar program relating to solid waste disposal problems which are caused by, and can be dealt with as part of, the extraction, processing, or utilization of minerals or fossil fuels.

This publication (*sw–2d*) has been prepared to disseminate concise up-to-date information concerning projects which received demonstration grant support prior to January 1, 1968. It is hoped that this information will be useful to those working in the solid waste field, will lead to productive interchanges between those having similar solid wastes problems, and will permit the widespread application of new and improved solid waste techniques which are being demonstrated by many of these projects.

—RICHARD D. VAUGHAN,
Chief, Solid Wastes Program.

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introduction

THE PRINCIPAL FEATURES of projects which received demonstration grant support from the Solid Wastes Program prior to January 1, 1968, are summarized herein. Abstracts for most of these projects previously appeared in the publications *Demonstration Project Abstracts—Solid Wastes Program*, dated March 1967, and *Supplement A* thereto dated August 1967. These earlier abstracts have been expanded and updated to December 31, 1967, in this publication, and summaries of new projects have been added. Annual revision and publication of these summaries is anticipated. Reports will be issued periodically which will contain abstracts of new projects funded in the interval between publication of these summaries.

Trade names are used in this publication solely to provide specific information. Mention of commercial products does not imply endorsement by the U.S. Public Health Service.

Organization of Summaries

Each project is identified by title, type, and grant number. The grantee, project director, cost and duration of the project is shown. Project objectives, procedures, and a brief statement of progress then follow to complete each summary.

Clarifying remarks concerning certain items of the summaries follow:

PROJECT TYPE: Each project is identified as a "Demonstration" or a "Study and Investigation" in accordance with categories described in the preface.

GRANT NUMBER: The Solid Wastes Program's identifying number for the project. This should be used in all contacts with the Program concerning the project.

GRANTEE: The recipient of the grant support. Grantees may be state, interstate, or local agencies of government, or public or private nonprofit organizations.

PROJECT DIRECTOR: The person designated by the grantee as having primary responsibility for conduct of the project.

ESTIMATED TOTAL PROJECT COST: The estimated total cost of the project over the entire project life.

GRANTEE'S SHARE: That portion of the estimated total project cost which will be borne by the grantee.

FEDERAL SHARE: That portion of the total estimated project cost which may be made available to the grantee as Federal grant support.

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Grant funds are committed to a project on an annual basis. For example, a project which will take three years to complete may receive the total Federal share in three annual increments, as indicated by the "01", "02", and "03" designations appended to the "Federal Share" amounts.

DATE PROJECT STARTED: The authorized beginning date of the project.

DATE PROJECT ENDS: The date by which the project will be completed. When circumstances warrant, a time extension beyond the original completion date may be authorized by the Solid Wastes Program.

Acknowledgments

Information used to prepare this publication was furnished by the Project Directors listed herein.

Solid Wastes Program personnel who contributed to the preparation of this publication were: Mr. Richard P. Lonergan, Chief, Demonstrations Grants Activities, provided overall advice and guidance; original drafts of the abstracts were prepared by Demonstration Grants Activities Project Officers R. Kent Anderson, Stanley J. Endlich, Eugene M. Herson, Thomas C. Jones, Steven J. Levy, Charles E. Orr, John A. Ruf, Robert P. Stein, and Richard J. Wigh; the manuscript copy was prepared principally by Donna L. Ritter, Mary J. Webster and Kay Blankenship.

demonstration grant projects

XI

Bagged solid wastes landfill project

PROJECT TYPE: Demonstration GRANT NO. D01-UI-00003

GRANTEE: Town of Barrington, Rhode Island

PROJECT DIRECTOR: Calvin A. Canney, Town Manager, 283 County Road, Barrington, Rhode Island 02806

ESTIMATED TOTAL PROJECT COST: $202,648
GRANTEE'S SHARE: $ 67,685
FEDERAL SHARE: $ 20,552 [01]
(by year of project life) $ 62,259 [02]
$ 52,152 [03]

DATE PROJECT STARTED: June 1, 1966 DATE PROJECT ENDS: May 31, 1969

OBJECTIVES: To demonstrate the feasibility and economics of combined collection and disposal of rubbish and garbage using kraft paper refuse sacks and to determine the effect of this collection method on the capacity of a sanitary landfill.

PROCEDURES: The project will be carried out by Town employees and supervisory personnel.

Approximately one-third of the community will be converted to the bag system during each year of the project. Costs of initiating and operating the system, and public acceptance of the changed collection method, will be evaluated. A model sanitary landfill operation will be instituted and space requirements in relation to this method of collection determined.

PROGRESS TO DATE: Various aspects of the bag system, products, and companies were investigated and holders and bags purchased from the St. Regis Paper Company under a three-year contract. On the basis of its investigations the Town decided to use a stand-type holder for the bags, with a drop lid and gasket, to allow the householder flexibility in placing the unit.

Prior to initiation of the system information was released to the press concerning the proposed bag system. In addition, an information packet was mailed to each householder explaining the nature of the proposed system. Conversion of one-third of the Town to the bag system was effected by September 28, 1966.

Reaction of homeowners to the bag system has been favorable. A questionnaire survey made in January 1967 indicated that 94 percent of the people using the bag system liked the change from cans to bags and would not want to go back to the former method of collection.

In the area using the bag system complaints have been reduced by approximately two-thirds, based on an analysis of comparable four-month periods prior to, and following, installation of the new system.

Failure of the bags due to animal attack has been more frequent than anticipated. In some cases it is felt that over-filling and improper closure has resulted in more attacks by dogs than would ordinarily have occurred. The bag has proved to be attractive to these animals after being placed at curb-side. To reduce these failures, the Town has proposed a local leash law, and also recommended possible changes in the bag itself to provide extra strength and less attractiveness to dogs.

Comparative operating costs between the old and new collection systems are being evaluated. Preliminary estimates indicate some reduction of collection costs for the bag system but further consideration of this is needed before firm conclusions can be reached.

Improvements are being made to the existing landfill to bring it into conformity with State and Federal recommendations. Studies of volume requirements are underway.

Conversion of an additional one-third of the Town to the bag system was effected during the second year of the project.

Solid waste reduction/salvage plant

PROJECT TYPE: Demonstration GRANT NO. D01–UI–00004

GRANTEE: City of Madison, Wisconsin

PROJECT DIRECTOR: John J. Reinhardt, Civil Engineer III, Engineering Department, Room 115, City–County Building, Madison, Wisconsin 53709

ESTIMATED TOTAL PROJECT COST:	$555,000
GRANTEE'S SHARE:	$185,000
FEDERAL SHARE:	$250,000 [01]
(by year of project life)	$ 60,000 [02]
	$ 60,000 [03]

DATE PROJECT STARTED: June 1, 1966 DATE PROJECT ENDS: May 31, 1969

OBJECTIVES: (1) To make an economic study of the Gondard Process of milling solid wastes as a means of reducing volume for the purpose of extending the life of a landfill; (2) to evaluate the sanitary aspects of milled solid wastes especially with respect to rodents, insects, odor, dust, blowing litter, and fires; (3) to determine the feasibility and sanitary aspects of using milled domestic solid wastes as collected from households, without separation, for deposit in a fill site without cover; (4) to evaluate the economic feasibility of salvaging items such as paper and metals; (5) to investigate physical changes in the condition of milled solid wastes versus unmilled solid wastes in the fill site.

PROCEDURES: A Gondard hammer-type reduction mill will be constructed to process a portion of the solid wastes produced in the City of Madison. The first year's milling operation will be conducted in twelve separate periods, each of one month's duration, in accordance with the following schedule: first month, combined domestic refuse; second month, domestic garbage only; third month, domestic refuse other than garbage. This sequence will be repeated three more times to permit evaluation of seasonal effects on each of the three categories of solid wastes. Milled refuse produced during each period will be placed in a separate landfill cell. The surface of each cell will be leveled by a front-end loader, and each cell will be packed occasionally by a bulldozer.

For control purposes, sanitary landfill cells of unmilled solid wastes will be constructed. Each control cell will contain the same weight of material as is placed in the corresponding milled-refuse cell.

For one cell of each type of refuse, three different grate mesh-sizes will be used in the mill, in order that an economic analysis may be made to determine the optimum mesh-size.

The economic and technical feasibility of the milling process will be evaluated. Studies will be made to determine reduction of landfill volume requirements for milled wastes, and comparative characteristics of milled and unmilled wastes relative to settlement, leaching, gas production, and rodent, insect, odor, dust and blowing litter problems.

Following completion of the test cells, milled solid waste will be worked into the City's regular landfill operation.

Landfill and milling operations will be conducted by employees of the City of Madison. The Civil Engineering Department of the University of Wisconsin will conduct the evaluation phase of the project, under the direction of Professor Gerard Rohlich.

PROGRESS TO DATE: The Gondard refuse mill was placed in operation on June 14, 1967, and shakedown operations conducted during the next three months. Some modifications of the equipment were found to be needed during this time. Major problems encountered with the mill itself were overheating of the motor, and frequent stoppages by large loads during the initial start up period. The motor overheating problem was solved by providing larger heaters for the motor. The frequent overloading of the mill was found to be due to slow response of the original automatic controls. This was corrected by modifying the controls and also allowing for hand stopping of the feed belts. Experience has demonstrated that optimum production is obtained when the mill operator visually monitors the feed and bypasses the automatic controls.

On September 18, 1967, milling of combined refuse for evaluating the project was begun. A summary of project operations from that date to December 31, 1967, as reported by the grantee, is given below:

As of December 31, 1967, rubbish, combined refuse, and garbage has been milled; a 55-mm, 100-mm, and 150-mm grate size has been used to try and determine an optimum grate size; a number of cells have been constructed and instrumented to obtain information on the characteristics of milled refuse and the suitability of milled refuse for uncovered landfill operations and market studies of salvage possibilities have been undertaken.

There appears to be little difference between milled combined refuse and milled rubbish. Milling garbage does not appear practical. The experience to date has shown that the milled combined refuse and rubbish can produce a satisfactory uncovered landfill. The experience with garbage has shown milled garbage does not produce a satisfactory material for an uncovered landfill.

Preliminary investigations into the possibilities of salvage have been discouraging as local salvage dealers have shown little interest in the rejected metal or dirty paper.

The demonstration project to date has proven that uncovered milled combined refuse or rubbish can successfully be used for landfill without causing any sanitary or aesthetic problems. At present, there is insufficient data available to attempt to project the cost of milling from a pilot plant basis to a system of mills that would mill all millable solid waste produced in the City of Madison. It is felt that the number of plant modifications and other changes that are under study for implementation in the next six months will substantially increase production capability of the mill and reduce unit production costs.

It is hoped that by January 1, 1969, all the experimental cells will be completed. A regular landfill operation can then be undertaken to compare a milled refuse landfill operation with a regular fill and cover operation. It is felt that the present method of using small cells, for comparing landfill operations using milled refuse with landfill operations using unmilled refuse, does not show the true apparent advantages of milled refuse.

Two large problems that affect the economics of the project remain to be solved. They are: (1) Finding a satisfactory method of handling the milled material from the mill to the landfill; (2) coordinating the mill operation with the collection operation.

It is anticipated that most major problems can be resolved by the start of the 03 project year in June 1968.

Solid waste disposal study for Kalamazoo County, Michigan

PROJECT TYPE: Study & Investigation **GRANT NO.** D01–UI–00005

GRANTEE: Kalamazoo County Road Commission

PROJECT DIRECTOR: E. L. Bockstanz, Engineer Manager, Kalamazoo County Road Commission, P.O. Box 2127, Kalamazoo, Michigan 49003

ESTIMATED TOTAL PROJECT COST: $12,000
GRANTEE'S SHARE: $ 4,000
FEDERAL SHARE: $ 8,000 [01]
(by year of project life)

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1967

OBJECTIVES: To develop the most effective plan for the county-wide disposal of solid wastes generated in Kalamazoo County.

PROCEDURES: The consulting engineering firm of Jones, Henry & Williams, Toledo, Ohio, will be retained to conduct the study. Local personnel will provide assistance to the consultant's staff, and data accumulated by local agencies will be made available. Major elements of the study will be as follows: (1) Determination of feasible methods of solid waste disposal from points of origin throughout the county, including possible consolidation of several of the existing 20 disposal sites now in operation. (2) Determination of feasible methods of disposal for solid wastes originating in the county's industrial complex, including paper mill and pharmaceutical wastes. (3) Recommendations of locations suitable for disposal sites to serve the entire county. (4) Determination of methods and estimates of capital and operating costs for solid waste disposal in the county. (5) Formulation of a plan for solid waste disposal which will lead to a demonstration of effective disposal methods on a county-wide basis.

PROGRESS TO DATE: The study was completed in the spring of 1967 and in his final report the consultant has made the following recommendations for a county-wide collection and disposal system: (1) To protect the public health and welfare all refuse collection and disposal should be placed under the authority of a single county agency. (2) A county-wide collection system of both garbage and rubbish should be instituted, which would include weekly residential collections using the set-out set-back method of pick-up. Cans and containers would be furnished by the county. The county should also collect commercial and industrial refuse, except for materials requiring special handling, or materials of large bulk; these should be collected by contract collectors. Such revisions in the existing system will reduce the cost of refuse service for all citizens of Kalamazoo County. (3) Sanitary landfill is the most economic method of refuse disposal available to Kalamazoo County at this time. A minimum of three sites for all solid waste will be a practical solution for residential, commercial and some industrial refuse. A separate site will be needed for such products as dried papermill sludges, construction and demolition debris, and tree wastes. (4) Special assessments should be levied against all properties producing solid waste both as a simple method of collection of revenue and as a way to avoid out of pocket payments. This source of funds can be supplemented by surcharges against commercial and industrial customers. (5) A planned program of public relations and public information should accompany any project undertaken by the County's refuse agency.

Hydrogeology of solid waste disposal sites

PROJECT TYPE: Study & Investigation **GRANT NO. D01–UI–00006**

GRANTEE: University of Illinois

PROJECT DIRECTORS: Robert N. Farvolden, Associate Professor of Geology, Department of Geology, University of Illinois, Urbana, Illinois 61801

George M. Hughes, Assistant Geologist, Illinois State Geological Survey, 115 South Washington Street, Naperville, Illinois 60540

ESTIMATED TOTAL PROJECT COST:	$98,632
GRANTEE'S SHARE:	$46,032
FEDERAL SHARE:	$47,031 [01]
(by year of project life)	$ 5,569 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To investigate hydrogeologic environments currently being used as sanitary landfills for solid waste disposal, and to evaluate the factors controlling ground water and landfill leachate movement in these environments.

PROCEDURES: The study will be conducted by staff members of the State Geological Survey and the Department of Geology, University of Illinois.

Several landfill sites in northeastern Illinois, representing some five different hydrogeologic environments, will be selected for study. A detailed boring program will be developed for each site, and investigations will proceed as follows:

Holes will be drilled by wash boring or with hollow stem augers and samples selected to describe the character and sequence of geologic deposits. Piezometers will be installed in the holes to define fluid potential distribution and thereby the ground water flow system. Water samples for chemical analysis will be collected from the piezometers whenever possible, and from additional borings that might be necessary for a definition of water quality. A program to monitor piezometer water levels will be continued for at least one year to define the seasonal variations in the ground water flow system.

PROGRESS TO DATE: Four sites were selected for study, one in DuPage County, one near Elgin, one near Woodstock, and one near Winnetka. Hydrologic investigations were conducted substantially in accordance with the planned procedures. The field work at all sites has been completed and the information is currently being compiled and evaluated. It is expected that the project will be completed in May 1968. Preliminary conclusions reported at this time appear below. These are subject to modification as final completion and interpretation of the data progresses.

DuPage County Site

A ground water mound 3 to 6 feet high has formed beneath the landfill, saturating the lower part of the refuse and producing springs along the sides of the fill. This mound developed by infiltration of precipitation through the fill cover. This infiltrating water could not be dissipated in the subsurface, as springs, or by evapotranspiration, as rapidly as it entered through the surface of the fill. The mound is apparently still developing, but equilibrium should be reached when one or more of the following increases to equal infiltration: (a) Evapotranspiration increases as the top of the zone of saturation approaches the surface. (b) Lateral leakage, through the surficial sand or as springs, increases as the groundwater mound becomes higher and gradients increase.

The steepest groundwater gradients are downward; however, the permeability of the underlying silty till is much lower than that of the surficial sand, and, therefore, the preferred direction of movement of the leachate from the refuse is laterally through the surficial sand.

The results of chemical analyses indicate: (a) No leachate is moving downward into the fractured dolomite, or into the thin interbedded sand within the silty clay till 30 feet below the base of the surficial sand. (b) Leachate can be detected 1,200 feet south of the fill area in the surficial sand.

Elgin Landfill

A groundwater mound has not formed beneath this fill. All water infiltrating through the fill cover is able to move away through the surficial sand and gravel below and adjacent to the site.

Leachate moves laterally through the surficial sand and gravel towards the Fox River.

No leachate has migrated downward into the interbedded gravels or the dolomite. This would not be expected as groundwater movement is upward, beneath most of the site.

Woodstock Site

As in the case of the Elgin site, lateral transmissibility is adequate to prevent the formation of a groundwater mound beneath the refuse. We believe that only the lower portion of the earlier deposits in this fill is below the top of the zone of saturation.

Leachate movement is through the surficial sands towards the drainage channel to the south and west. There is no evidence of leachate migrating downward below the base of the shallow gravel.

Winnetka Site

As at the DuPage County site, a groundwater mound approximately 7 feet high has formed beneath the fill and a few springs have developed along the sides. This mound is more pronounced than the mound at DuPage County, as the transmissibility of the materials below and adjacent to the fill is lower.

Leachate has been detected up to 300 feet away from the fill, in the near-surface sandy silt. Early sampling points indicated that leachate at this site was migrating downward; however, subsequent borings made to verify this migration showed that earlier results were probably caused by leaking piezometer seals, and that there was no migration of leachate to depth.

SUMMARY

1) At all four sites studied refuse leachate was migrating from the disposal area. With the possible exception of the Elgin site, it does not, at the present time, appear that this leachate is contaminating a useful source of groundwater or creating any serious problems where it reaches the surface. An evaluation of the suitability of each site will be made in cooperation with the State Health Department when final data compilation is completed.

2) The hydrogeology at each site was such that leachate migrated laterally through permeable units near the surface, and did not move downward to underlying units. Fine textured materials with low permeability were very effective in preventing migration of leachate.

3) The presence of groundwater mounds under the Winnetka and DuPage County sites demonstrates that precipitation in this area will penetrate normal cover materials and leach the underlying refuse.

Solid waste study and planning grant — Jefferson County, Kentucky

PROJECT TYPE: Study & Investigation **GRANT NO. D01-UI-00007**
GRANTEE: University of Louisville, Institute of Industrial Research
PROJECT DIRECTOR: Dr. John E. Heer, Jr., Professor of Civil Engineering, University of Louisville, Louisville, Kentucky 40208
ESTIMATED TOTAL PROJECT COST: $131,880
GRANTEE'S SHARE: $ 43,960
FEDERAL SHARE: $ 43,960 [01]
(by years of project life) $ 43,960 [02]
DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To develop a regional plan for disposal of solid wastes originating in Jefferson County, Kentucky.

PROCEDURES: The project will be conducted by staff of the University of Louisville Institute of Industrial Research, Departments of Civil and Chemical Engineering.

Sources and quantities of solid wastes generated in the study area will be determined. Methods of solid waste disposal most suited to the area and the type of waste generated will be investigated. Alternate methods of waste disposal will be studied with emphasis on a regional planning approach. Possible disposal sites will be investigated.

PROGRESS TO DATE: A 12-month program of domestic refuse sampling has been completed. Preliminary results indicate that domestic refuse production is about 1.95 lb per capita per day, constituted as follows:

Combustibles	*% by Weight*	*% by Volume*
Food Wastes	20	8
Other	59	72
Total	79	80
Noncombustibles	*% by Weight*	*% by Volume*
Metals	9	14
Glass	11	5
Minerals	1	1
Total	21	20

Preliminary chemical analysis of the combustible domestic refuse is as follows:

	Food wastes	*Paper and other combustibles*
Moisture (%)	60.3	23.5
Ash (% dry wt.)	15.2	5.9
Lipids (%)	28.9	7.5
Calorific value (Btu/lb)	9,500	8,500
Carbon (%)	43.2	44.7
Hydrogen (%)	9.4	7.4
Oxygen (%)	26.6	40.7
Nitrogen (%)	2.9	0.4
Phosphorous (%)	1.1	0.2
Sulfur (%)	—	1.3
Potassium (%)	0.8	0.1

A questionnaire was mailed to each of the 325 manufacturing industries in the county having 25 or more employees. Over 80 percent of the questionnaires were completed and returned. Preliminary results indicated that an estimated 8.7 million pounds per week of industrial refuse are generated. 62 percent of this amount is collected by private or municipal haulers; 19 percent is disposed of by industry on its own property; and 19 percent is salvaged. Most of the industrial wastes consist of wood, foodstuffs, paper, minerals (primarily refractory sand) and glass. The questionnaire study is being followed up by interviews with refuse collectors and industry representatives to confirm data provided. Because of the nonhomogeneous nature of these wastes, and the large number of sources, it was decided that a statistical analysis, similar to that done on domestic refuse, will not be possible for industrial wastes.

Questionnaires were also employed in an attempt to develop information concerning quantities and composition of commercial refuse. About 20 percent of these questionnaires were completed and returned. Followup interviews with commercial establishments have been disappointing. It would appear that most commercial concerns do not know the quantities of refuse they generate, but only how much it costs to have it removed, and become concerned only if something goes wrong or the cost increases. Records of private haulers and city sanitation departments are being analyzed in an effort to develop quantitative data for this type of work.

Analysis of demolition and construction wastes has been found to be especially difficult due to lack of raw data and differing systems used by each demolition company to compute quantities. Sites used for disposal of these wastes have been located and a method for estimating quantities of these wastes is being developed.

Investigations of salvage, sewage sludge, junked autos, and horticultural wastes are also under way.

Studies are being made of existing solid waste collection and disposal systems in the county. At present there are 15 major disposal organizations operating, of which 12 are privately owned, and 3 municipally operated. Information concerning the population served, quantities and volumes of wastes collected, haul distances, collection routes, disposal methods and location of disposal sites, is being obtained by visits to the disposal organizations. Visits to the disposal sites are being made to determine such factors as remaining capacity available, operational procedures, sanitation, and amount of refuse handled. A mathematical model is being developed to provide those who must eventually implement any proposed disposal plan with a basis for selecting transfer and disposal sites.

It is proposed to expand the scope of this study to include Clark and Floyd Counties, Indiana, so that the entire Louisville Metropolitan area is considered. Plans are being developed by the grantee for this addition.

High-density landfill recovery program

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00009

GRANTEE: King County Sanitary Operations, 608 King County Courthouse, Seattle, Washington 98104

PROJECT DIRECTOR: John Nicholson, Assistant Director, King County Sanitary Operations

ESTIMATED TOTAL PROJECT COST:	$701,646
GRANTEE'S SHARE:	$324,307
FEDERAL SHARE:	$250,000 [01]
(by year of project life)	$127,339 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To construct and operate a machine which will compact refuse at 200 psi, extrude the compacted refuse substantially below ground level, and compact cover material placed over the in-place refuse by auxiliary earthmoving equipment.

To determine the suitability of land reclaimed by this method for use as a building construction site that will not settle or slump.

PROCEDURES: A prototype compacting machine, capable of handling about 2000 tons of solid wastes per day, will be constructed and operated at King County's Cedar Hill landfill site. Operating costs and characteristics of the compacting machine, and settlement and bearing characteristics of the fill, will be determined. Gas production in the fill will be investigated.

The firm of Johnston, Campanella, Murakami and Company, Renton, Washington, will provide design, evaluation, and other necessary consulting engineering services.

A film, documenting the project from initial conception through final evaluation, will be produced.

PROGRESS TO DATE: Changes in design and delays in construction have caused the project to fall several months behind schedule. It is estimated that the project will not be completed until the latter part of 1968.

Bids for construction of the compacting machine were awarded on September 18, 1967. It is anticipated that the machine will be essentially completed and moved onto the demonstration site in March 1968. The main hydraulic cylinders will be installed at the site, and the machine will then be ready to begin operations. Scales have been installed at the site for use in project evaluation. The County's transfer trailers have been modified so as to permit easy dumping of solid wastes into the compacting machine. They have been converted from the conventional end-unloading type to a type having two 42-cubic-yard containers on the truck bed. These containers are filled with solid wastes at the transfer station and emptied at the site by being removed one at a time by a hydraulic unloader and turned upside down. Use of this system indicates that unloading takes about 1/3 as long as older methods, and also enables the site to be kept considerably cleaner.

Waste incineration in mechanically agitated fluidized beds

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00010

GRANTEE: Board of Governors, West Virginia University

PROJECT DIRECTOR: Richard C. Bailie, Associate Professor, Department of Chemical Engineering, West Virginia University, Morgantown, West Virginia 26506

ESTIMATED TOTAL PROJECT COST:	$170,107
GRANTEE'S SHARE:	$ 61,424
FEDERAL SHARE:	$ 59,103 [01]
(by year of project life)	$ 49,580 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVE: To conduct a quantitative study of the extent to which the many potential advantages of the fluidized bed for cleaner and more economical disposal of a wide variety of solid wastes may be realized.

PROCEDURES: The project will be conducted by staff of the Department of Chemical Engineering, the Department of Civil Engineering, and the Engineering Experiment Station, West Virginia University, and will be carried out in three phases as follows:

Phase I. A fluidized bed pilot plant will be designed and constructed. Operating characteristics will be determined, and the effects of a number of factors on bed operation will be evaluated. Garbage mixed with rubbish will be treated. An economic analysis of fluidized bed burning of refuse and rubbish as a source of energy for a steam generating plant will be developed.

Phase II. Based upon information and experience gained in Phase I, the equipment will be modified or overhauled for the incineration of sewage sludges. The experimental investigation will follow the pattern of Phase I.

Phase III. Based upon the results obtained in Phases I, and II, optimization studies will be carried out on the disposal of wastes in fluidizing beds. Consideration will be given to plants for the incineration of garbage and rubbish, sewage sludges, and combination plants for cities of various sizes.

A final report will be prepared describing the advantages and disadvantages of a fluidized bed incinerator as demonstrated on a pilot plant scale for several types of solid wastes. The optimum system for several case studies, including heat recovery, sewage sludge disposal, etc., will be given. The system will take into account both cost and necessity of cleaner effluent. The comparison of fluidized bed incineration with other methods of disposal will be presented.

PROGRESS TO DATE: The project is behind schedule due to difficulties in obtaining equipment, and in commitment of personnel to the study. It is approximately 50 percent complete, and it is anticipated that the project life will be extended one year—to May 31, 1969.

The fluidized bed pilot plant has been completed and run for several hundred hours. Several feed materials were studied. These included shredded paper, sewage sludge, chicken droppings, sawdust, wet sawdust, anthracite coal and high coking coal. Both batch and continuous feed experiments have been conducted.

These experiments have established the operating characteristics of the bed. It has shown that the bed is stable, control of temperature is simple, that isothermal operations are achieved, the burner design is adequate, the simple scrubbing system installed is effective and the predicted heat release rates can be achieved.

The experiments have shown the major problem that must be resolved is a method for controlling the feed to the bed. The large variety of feed characteristics make this the major obstacle. Of the feed types given above, only anthracite coal has been fed successfully for prolonged periods.

A preliminary economic analysis of the fluidized bed incinerator has been made. These preliminary figures indicate that a bed of 12 feet diameter serving a town of 100,000 persons can recover the cost of incineration if the process steam can be marketed.

The most important problem to be solved is the feeding system and this will receive top priority. As soon as the feed system is operational, the bed will be fed with coke, sawdust-water mixtures, sewage sludge and shredded paper. Complete energy and material balances will be run. The feed will be analyzed and heating value determined. The combustion gas will be analyzed for CO_2, O_2, CO and N_2. The bed will be cooled by evaporation of water in the bed, allowing increased feed rates. The stack will be analyzed for dust loading and the heating value of and composition of dust collected evaluated. The performance characteristics of the scrubbing system will be evaluated. Mixed refuse studies will follow this investigation.

Information concerning Fluidized Bed Incineration. The investigations underway have been presented by project personnel to the Engineering Foundation Research Conference, Solid Waste Research and Development, Milwaukee, Wisconsin, July 1967, and to a conference of newspaper science writers held at West Virginia University in October 1967. A paper has also been submitted for presentation at the National Incineration Conference to be held in New York City in March 1968.

Two other investigations have been initiated by others as a result of interest generated by this project:

A fluidized bed incinerator is being mounted on a flat bed truck to serve as a mobile unit in waste disposal from large cattle feed lots in Kansas. This work is being directed by Dr. L. T. Fan of Kansas State University, in cooperation with that institution's Agricultural Experiment Station. The unit is expected to be ready for testing in the spring of 1968.

Dr. C. Y. Wen, Department of Chemical Engineering, West Virginia University, is studying high temperature solid gas reactions under a National Science Foundation Grant for the study of reaction kinetics. Studies are to be initiated to develop a fundamental understanding of the kinetics of combustion of various solid wastes. This type of information will permit a fuller understanding of incineration in order to develop improved techniques for the combustion of solid wastes.

Gully reclamation method—landfill demonstration

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00011

GRANTEE: Sarpy County Board of Commissioners, Sarpy County Courthouse, Papillion, Nebraska 68046

PROJECT DIRECTOR: John W. Neuberger, P.E., General Manager, Papio Watershed Board, 4538 South 84th Street, Omaha, Nebraska 68127

ESTIMATED TOTAL PROJECT COST:	$146,550
GRANTEE'S SHARE:	$ 55,950
FEDERAL SHARE:	$ 48,000 [01]
(by year of project life)	$ 21,300 [02]
	$ 21,300 [03]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1969

OBJECTIVES: To demonstrate the feasibility of erosion control and land reclamation in gullied areas by sanitary landfill operations, and to promote acceptance of landfills for solid waste disposal.

PROCEDURES: A gully in the Papio Watershed area of Sarpy County will be selected for a sanitary landfill site. A dam, with a suitable spillway will be erected across the lower end of the gully, with due regard to preventing landfill seepage from polluting the downstream waterways. Landfill operations will begin at the upstream end of the gully and progress toward the dam. The usual sanitary landfill appurtenances will be included, such as access roads, scale and scale house, fencing, gates, etc. Data on the amount and types of waste materials placed, cover depth, compaction and settlement will be collected. Seepage water samples will be taken to determine the chemical and biological characteristics of internal drainage water.

Project evaluation will include: (1) findings on management and operation requirements to obtain community acceptance of the landfill methods employed; (2) determining landfill site costs, financing, and user rates for solid waste disposal; (3) determining the value of gully reclamation by sanitary landfill operation in accomplishing conservation, controlling runoff channel grade, countryside beautification, and satisfactory solid waste disposal.

The project will be conducted by the Staff of the Papio Watershed Board. The firm of Gollehon & Schemmer, Inc., Omaha, Nebraska, will provide consulting engineering services in connection with the necessary construction to prepare the landfill site for use.

PROGRESS TO DATE: An eroded gully on farm land approximately 10 miles south of Omaha was selected to serve as the demonstration site. The gully was cleared of all trees and brush and an earth dam constructed at its mouth in order to establish a stable grade for the landfill, and prevent seepage from moving downstream. An all-weather access road was built to the site, the site area was fenced, and scales and administration hut provided.

Landfill operations began in April, 1967. The operation is run by a three man crew. One man weighs all incoming loads, collects fees ($0.35 per cubic yard), records volume, source, and type of waste, and maintains weather data. A second man directs vehicles to the dumping area and places the wastes with a front end loader. The third man compacts the wastes with a TD-18 bulldozer, and covers them with a scraper pulled by the dozer.

A "Public Disposal Area," available for use by private individuals 24-hours per day, has been provided immediately adjacent to the fenced site area. Two 10-cubic-yard containers are placed here, and anyone with a small amount of wastes can deposit them in a container. There is no charge for this service.

Water samples are taken routinely from the base of the tile field in the dam, and from a 90-foot deep well below the dam. Chemical analyses are run monthly, bacteriological analyses weekly. So far the landfill has had no observable effect on water quality.

All trees and bulky items received are placed in a second gully adjacent to the main gully. Upon completion of the landfills a comparison of bearing capability, settlement and density will be made.

Daily record sheets on refuse hauled into the landfill are completed by the full-time site operator. A summary of these daily records through September 30, 1967, provided these preliminary statistics:

A) Total weight of refuse placed into the gully landfill .... 3,051 tons
B) Total volume of refuse delivered to the landfill ....12,804 cu yds
C) Volume of gully displaced by refuse and soil ....29,000 cu yds
D) Daily amounts of refuse delivered range from 50 to 200 cubic yards per day, this is equivalent to a city of around 20,000 population.
E) Present operating cost are running at $60.00 per day, using present average daily volume of 100 yds., the cubic yard cost is sixty cents plus capital improvement, such as, haul roads, dams, and land.
F) Refuse deposited into the "Dempster" containers stationed at the Public Disposal Area has been as follows: June—11.2 tons, July—9.5 tons, August—9.8 tons, and September—19.1 tons. It can be assumed that without such a public facility available, much of this would have littered the countryside.

From the operation to date only tentative conclusions can be drawn. 1) The project has already received a great deal of public and professional interest and is serving as a useful demonstration of the operation of a sanitary landfill at acceptable public standards. 2) The trenching method of landfill in a gullied area seems to work satisfactorily with the use of a TD-18 dozer for covering and compaction. 3) Public use of the off-site refuse disposal facilities has been beyond expectations. A decrease in trash dumping along road sides and into creek channels has been evidenced in the urbanized area influenced by this project.

Multi-purpose incinerator

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00013

GRANTEE: City of Stamford, Connecticut, 429 Atlantic Street, Stamford, Connecticut 06901

PROJECT DIRECTOR: Norman W. Wagner, Supervisor of Sanitation, Bureau of Sanitation, Magee Avenue, Stamford, Connecticut 06901

ESTIMATED TOTAL PROJECT COST:	$830,000
GRANTEE'S SHARE:	$560,000
FEDERAL SHARE:	$250,000 [01]
(by year of project life)	$ 20,000 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To design, and operate a multi-purpose incinerator to demonstrate the feasibility of incinerating solid wastes that normally are too bulky or volatile for charging to a conventional incinerator, and to demonstrate the practicability of using an electrostatic precipitator to meet State and Federal air pollution criteria.

PROCEDURES: The proposed incinerator will be designed and constructed. The City will develop operational procedures for the facility, and evaluate its performance with the assistance and advice of Elmer R. Kaiser, Advisory Consultant for the project. Elements of the evaluation phase of the project will include: (a) accurate measurements of weights and volumes of all wastes handled, (b) development of rules and regulations governing the delivery of wastes to the incinerator, (c) development of methods of controlled burning, determination of the compatability of varying types of wastes for joint burning, methods of charging the chamber, operating temperatures, draft measurements, and effectiveness of the electrostatic precipitators.

PROGRESS TO DATE: The consulting engineering firm of James P. Purcell Associates, Hartford, Connecticut, was retained to prepare the plans and specifications for the incinerator, provide assistance in the securing of bids, letting of the contract, and supervision of construction. Bids were opened in October 1967 and were substantially higher than the estimates. This resulted in a delay of several months, while arrangements were made to secure the necessary additional funds to proceed with the project. Sufficient funds are now available to proceed and it is expected that construction should start by March 1968. This will delay completion of the project to a later date than originally anticipated.

Land reclamation by accelerated stabilization and related studies of compactor equipment

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00018

GRANTEE: City of Santa Clara, 1500 Warburton Avenue, Santa Clara, California 95050

PROJECT DIRECTOR: Ralph Stone, President, Ralph Stone & Co., Inc., Engineers, 10954 Santa Monica Boulevard, Los Angeles, California 90025

ESTIMATED TOTAL PROJECT COST:	$387,535
GRANTEE'S SHARE:	$149,815
FEDERAL SHARE: (by year of project life)	$ 76,500 [01] $ 94,100 [02] $ 67,120 [03]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1969

OBJECTIVES:

(1) To demonstrate the use of aeration in sanitary landfills to provide more rapid stabilization, increased capacity, and land reclamation for construction and other uses.

(2) To compare the densities achieved in sanitary landfills using various types of compaction equipment.

I. Land reclamation by accelerated stabilization

PROCEDURES: The project will be carried out by Ralph Stone & Co., Inc., Los Angeles, California, over a three-year period. Test cells will be constructed and operated to demonstrate and compare conventional anaerobic sanitary landfill procedures with two types of aerated landfills, and their respective efficiencies in reclaiming land for industrial park use. One aerobic test cell will demonstrate the principle of composting and the second will demonstrate the principle of controlled high-rate oxidation to achieve an oxidized residue suitable for final land disposal. The proposed program is divided into the following three phases: *Phase 1.* Demonstration of the method of reclaiming landfills by rapidly oxidizing the refuse to a residue and comparing the results of this process with the composting cell and the conventional anaerobic control cell. *Phase 2.* Refinement of this process, supplemented by additional studies. *Phase 3.* Demonstration of full-scale aerobic or other improved disposal methods, industrial park land reclamation, and development of appropriate cost and land reclamation maintenance experience.

PROGRESS TO DATE: Preparatory to initiating the large scale field demonstration program for the rapid oxidation and stabilization of solid wastes, certain pilot plant facilities were established at the project engineer's laboratory to demonstrate improved volume reduction. The concepts employed included (1) underground incineration; (2) rapid biological oxidation by controlled aeration, moisture application, heating and natural thermophilic heat generation; (3) improvement of odor and particulate filtration and adsorption by varying the soil cover in terms of depth, type, moisture content and charcoal admixture; and (4) other chemical and physical methods for accelerated degredation.

Important pilot study findings are: (1) Biological oxidation required both controlled aeration and moisture. The pilot studies, although affected by the ambient environment, have improved operating technology and defined potential problem areas for the large scale field demonstration. (2) The tests indicate that underground refuse incineration is technically feasible. However, further pilot studies are required to define practical limitations and optimize various parameters. A major advantage of the process is the effective oxidation due to the high temperatures resulting from the insulating effects of the earth blankets and the long burning contact period with low air velocity and soil filtration which minimize air pollution.

A test was conducted to determine the effects of excavation and recompaction of a normal anaerobic landfill, in terms of volume compaction density relationships, at the Santa Clara landfill site. A year-old anaerobic cell was excavated and the excavated solid waste recompacted into a new cell. The volume of solid waste excavated from the old cell was determined to be 530 cu yd, whereas the volume of recompacted waste in the new cell was 667 cu yd, indicating a net expansion of 25.6 percent. Settlement markers have been placed on a recompacted cell and other cells to determine settling rates. Characteristics of the recompacted cell and other cells will be determined as part of the overall test by core samples.

Two aerobic landfill demonstration cells have been constructed, each measuring about 50 x 200 feet at the bottom, 85 x 270 feet at the top, with a depth of 17 feet. Aeration systems, consisting of a piping grid, blowers, valving and appurtenances have been placed in the bottom of each cell. Construction of the cells was completed by the end of May 1967, and filling of cell no. 1 with municipal refuse from Santa Clara was begun. By the end of November, cell no. 1 was almost filled. At this time filling of this cell was temporarily discontinued to dispose of refuse into cell no. 2. Aeration cell no. 1 has been continually monitored for gas composition, temperature, and humidity. Refuse has been sampled for determinations of composition, moisture content, and organic matter.

A preliminary test program indicated that the rate of refuse decomposition increased with the mechanical addition of air. Six-month-old aerated refuse has shown signs of advanced decomposition. The aerated mixture, when uncovered, exhibited a black, charred appearance, garden trimmings were moist and soft, and paper was illegible. Some of the residue appeared almost burned. The mixture is at about 170°F, usually steaming, with an odor somewhat like a hot sweet tobacco smell.

A preliminary cost analysis of several alternative methods of processing and disposing of 250 tons per day of domestic refuse was made. The total per ton processing and disposal cost for the case study was projected to be $8.53 for incineration, $1.50 for normal sanitary landfills, $4.29 for composting, and $1.78 for controlled aeration, disregarding the ultimate value of the completed landfill. It should be noted that this preliminary analysis for the particular case study may be optimistic. Refinements will be made after operating results of the aeration and compaction demonstrations become available.

Some of the work performed under this grant has been reported in the following publication:

Stone, R., and M. Israel. Determining effects of recompaction on a landfill. *Public Works*, 99(1): 72-73, Jan. 1968.

II. Studies of compactor equipment

PROCEDURES: The relative effectiveness of a D-9 caterpillar and an F. W. Wagner WC-17 rubber-tired compactor in compacting domestic refuse will be demonstrated. The compaction obtained using an SF-17 Wagner steel-tired compactor will be demonstrated and compared to that obtained with the previous equipment.

PROGRESS TO DATE: Compaction cells 3 and 4 were excavated in August 1967, and filling began. Both cells were nominally 35 feet wide by 110 feet long by 9 feet deep. The D-9 caterpillar spread and compacted refuse in cell no. 3, and the rubber-tired Wagner spread and compacted refuse in cell no. 4.

The refuse was normal municipal rubbish, mostly garden trimmings and paper, plus garbage admixed to the rubbish. Initially, refuse was placed in cell no. 3 and worked by the D-9 for one week; the next week the Wagner worked cell no. 4. Thereafter, the intervals of working one cell and then the next were shortened so that a good relationship between type of refuse, moisture content and density achieved could be maintained. Equipment breakdowns slowed progress. Surveys were made periodically to determine the volume of the compacted refuse in each cell. The survey data was plotted on cross sections, landfill volumes were calculated, the weight of refuse was tabulated based on the weighmaster's records, and landfill densities calculated.

When compaction cells 3 and 4 were brought to grade with refuse, they were surveyed. After a 2 foot soil cover was placed, another survey was made and bench marks established on the cells. Resulting settlement will be periodically measured.

Aeration cell no. 1 was also used for the compaction studies. Both the rubber-tired Wagner and the D-9 caterpillar were used for spreading and compacting the refuse. The D-9 was used more than the Wagner, but no effort was made to distinguish which equipment was used.

Densities obtained, which have been rechecked, are tabulated below:

		Densities, lb/cu yd		
Cell no.	*Equipment*	*Refuse before soil cover*	*Refuse after soil cover*	*Final, including wt of soil cover*
1	D-9	1150	N.A.	N.A.
3	D-9	1050	1210	1600
4	Wagner rubber-tired	1150	1280	1650

Time studies were conducted during the comparative compaction tests. Following mixture of the separately-collected household garbage with the municipal refuse, the time required for spreading and compacting of the combined refuse in the cell was recorded. The procedure was repeated for both the rubber-tired Wagner and the D-9 caterpillar with the same operator and the same instructions for compaction procedure. The time for spreading and compacting the refuse, exclusive of soil cover, was calculated, along with the total tonnage that was compacted in place. Results to date are tabulated below:

Equipment	*Total tonnage compacted*	*Total Operating Time (hours)*	*Tons/hr*
D9	1985	59.75	33.2
Wagner (rubber-tired)	330	10.70	30.8

Based on the data to date, the D-9 appears to accomplish the task of spreading and compacting at a rate approximately 10 percent faster than the Wagner.

Further time studies are being conducted to amplify these results. Additional data is being gathered concerning equipment down-time and operating costs.

Jefferson Parish West Bank refuse collection and disposal study

PROJECT TYPE: Study & Investigation **GRANT NO.** D01–UI–00019

GRANTEE: Jefferson Parish Council, Parish of Jefferson, New Courthouse, Gretna, Louisiana 70053

PROJECT DIRECTOR: Jerome Pepper, President, Pepper and Associates, Inc., 816 Howard Avenue, New Orleans, Louisiana 70113

ESTIMATED TOTAL PROJECT COST:	$28,007
GRANTEE'S SHARE:	$ 9,692
FEDERAL SHARE: (by year of project life)	$18,315 [01]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** March 30, 1968

OBJECTIVES: To develop a regional plan for the collection and disposal of solid wastes now being handled by the four separate Garbage Districts of the West Bank of Jefferson Parish.

PROCEDURES: The consulting engineering firm of Pepper and Associates, Inc., New Orleans, La., will conduct the study. Results of this study will be incorporated within the New Orleans metropolitan comprehensive report (see summary for Grant No. D01–UI–00063).

Existing collection systems will be analyzed to determine their efficiency, adequacy, and economics. Total quantity of solid wastes generated in the study area will be determined, and projections of future expected solid waste production will be made. The feasibility of reorganizing existing collection systems to provide the most economical and efficient area-wide service will be evaluated. Use of transfer stations will be considered.

The cost of rehabilitation of existing incinerator facilities, and the anticipated remaining life of the existing landfill, will be determined. The need for new incinerator and landfill facilities will be investigated. Size, location, and costs will be estimated. Other methods of disposal will be reviewed.

Costs of operating an area-wide collection and disposal system will be estimated for the present time, and for a future 20-year period. This will be compared to costs of the methods now being used.

PROGRESS TO DATE: The consulting engineer has completed all of the field work in connection with the study. Preliminary conclusions reported by the consultant from observations made and current analysis of the data obtained are as follows: Collection trucks of from 18-to 20 cu-yd-capacity probably would be the most efficient type for this area. A twice-a-week pickup, rather than the present three-day-per-week pickup, would be adequate for the area, would increase efficiency of the collection operation, and would reduce the cost. It was observed that the larger the truck the higher the degree of compaction. Some figures developed for collection costs are shown below:

Truck size (cu yd)	*Refuse density (lb/cu yd)*	**Collection cost ($/ton)*	*†Vehicle operating costs ($/hr)*
16	465	5.90	7.30
18	570	5.00	7.70
20	600	4.50	7.70

* Does not include travel time between garage and collection area and between disposal site and collection area.

† Does not include labor.

Provision of a scale at the disposal site is important, as this provides an easy way to check the performance of a collection crew. The present incinerator is nearly 20 years old, in need of repairs, obsolete, and costly to operate. This facility should be abandoned since the cost of rehabilitation to modernize it or increase its capacity would not be worth the expense. Recommendations relative to a new incinerator are being developed.

At the present time the Parish does not own the landfill site to which most of the solid wastes are hauled. A large available tract of land should be purchased for use as a landfill site.

It is estimated that the population of the West Bank will more than double within the next 20 years, if it continues at its existing rate of growth. Preliminary figures indicate that within this period over two million dollars worth of new or replacement rolling collection equipment will be needed.

A study is recommended to consider the feasibility of a central transfer station for the entire West Bank, where refuse could be put into barges and floated down the Bayou to a landfill site 10 or 12 miles away from the main populated area of the Parish.

This project as currently constituted provides for a study of only the unincorporated areas of the West Bank. The two incorporated municipalities in this area—Westwego and Gretna—collect and dispose of their solid wastes separately from the existing Garbage Districts. Plans are being developed to supplement the existing project by inclusion of those communities, so as to consider one central refuse collection and disposal system for the entire area.

Recreational use of waste incinerator heat

PROJECT TYPE: Demonstration **GRANT NO. D01–UI–00020**

GRANTEE: County of Bergen, New Jersey

PROJECT DIRECTOR: Richard L. Nelson, Assistant Executive Administrator, County of Bergen, Administrative Building, Hackensack, New Jersey 07601

ESTIMATED TOTAL PROJECT COST: $4,374,065

GRANTEE'S SHARE: $3,963,375

FEDERAL SHARE: $ 200,000 [01]
(by year of project life) $ 195,312 [02]
$ 15,378 [03]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1969

OBJECTIVES: To demonstrate that municipal refuse and other solid wastes can be incinerated without significantly polluting air or creating a public nuisance, and that incinerator waste heat can be used to operate recreational facilities.

PROCEDURES: A 600-ton-per-day incinerator will be constructed in Overpeck Creek Park, a recreational area which the county has been developing since the mid-1940's. The incinerator will be equipped with air pollution control devices adequate to eliminate any possible smoke and odor nuisance. A swimming pool and ice skating rink will also be built and waste incinerator heat utilized as a power source for their economical and efficient operation. Economics and practicability of the project will be evaluated.

The firm of B. B. Reilly and Associates, Ridgefield, New Jersey, will be retained to prepare plans and specifications for the incinerator and provide consulting engineering services in connection with its construction. The firm of Wank, Adams and Slavin, New York, New York, will be retained to provide architectural and engineering services required for the development of a preliminary project plan and analysis regarding the proposed recreational complex adjacent to the incinerator.

PROGRESS TO DATE: Contracts were signed with the two consultants in November 1966, and preparation of plans and specifications for the incinerator initiated. Preliminary plans have been completed and are being reviewed.

In January 1967, the Township of Teaneck, New Jersey, filed suit seeking a court order to prevent the county from constructing the incinerator in Overpeck Creek Park. This matter is currently still in litigation and any further progress on the project is dependent upon resolution of the suit.

California integrated solid waste management system

PROJECT TYPE: Demonstration GRANT NO. D01–UI–00021

GRANTEE: California State Department of Public Health, 2161 Berkeley Way, Berkeley, California 94704

PROJECT DIRECTOR: Richard F. Peters, Chief, Bureau of Vector Control, Division of Environmental Sanitation, State Department of Public Health

ESTIMATED TOTAL PROJECT COST:	$408,906
GRANTEE'S SHARE:	$151,426
FEDERAL SHARE:	$134,169 [01]
(by year of project life)	$123,311 [02]

DATE PROJECT STARTED: June 1, 1966 DATE PROJECT ENDS: May 31, 1968

OBJECTIVES: To apply systems analysis and management science techniques to the study and design of a regional solid waste management system wherein all facets of the solid waste problem would be included.

PROCEDURES: The Fresno Area, which can be considered as that portion of Fresno County within a 20 to 25 mile radius of the City of Fresno, will be the study area.

The State Department of Public Health will conduct the overall study, with assistance by local agencies in the Fresno area, other State agencies, and San Francisco State College. Consulting engineering services will be furnished by the Aerojet–General Corporation, El Monte, California, in cooperation with Engineering-Science, Inc., Arcadia and Oakland, California.

Quantities and sources of solid wastes will be determined by field inventory of all existing waste producers. Estimates of future quantities and types of waste production will be made. The present methods of handling solid wastes will be determined by field surveys. Standards will be developed for the handling of solid waste products and for environment quality to be maintained. Jurisdictional constraints which limit governmental ability to manage solid wastes on a regional basis will be identified, and an organizational framework by which such regional management may be effected will be developed. Exisiting and potential solid waste technical capabilities will be defined and an investigation will be made of the feasibility of applying this advanced technology to the regional management of solid wastes in the Fresno area. A program of public education and information to create a background of public awareness and understanding of the solid waste problem will be designed. Preliminary designs and specifications will be prepared for several alternative programs or systems to satisfactorily handle the solid wastes of the Fresno area. Criteria and methods to be utilized in evaluating the alternative systems on the basis of their economies, efficiencies, and environmental effects, will be defined.

PROGRESS TO DATE: The technical aspects of the project, comprising the systems analysis study, are being carried out by the consultant. This has involved the collection of engineering, socioeconomic, and jurisdictional data, definition of solid waste problems, development of an effective measuring procedure, and conceptualization and evaluation of alternative solid waste management systems for the study area. All of the field and survey work involved has been completed. The consultant's final report is in preparation. Expected completion date is March 31, 1968.

Concurrent with the above, the State Health Department has carried out other phases of the overall project.

A public awareness program to prepare residents of the area to accept the recommendations of the "systems analysis" study has been carried out. This involved informational releases, talks, and personal contacts with community officials, influential members of the various communities, and the general public. A motion picture illustrating the deleterious effects of uncontrolled and/or mismanaged solid wastes on the environment was produced for use in the public awareness program.

Entomological investigations were undertaken to define the criteria for solid wastes management in the study area to obviate insect production. Criteria for managing solid wastes so as to control domestic fly production and other problems associated with mismanaged wastes, have been developed.

The project is proceeding on schedule and is expected to be completed by May 31, 1968.

This study has had the enthusiastic support of the officials of Fresno County and the 26 communities in the study area. The County Board of Supervisors has passed regulations to stop open burning and dumping of solid wastes near the more populated areas of the county and begun work on the development of regulations concerning the collection and disposal of solid wastes such as refuse, commercial wastes, and automobiles.

Quad-City regional solid waste program

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00026

GRANTEE: *Quad-City Solid Wastes Committee, City Hall, Paterson, New Jersey 07505

PROJECT DIRECTOR: Frank P. Francia, P.E., Room 53, City Hall, Paterson, New Jersey 07505

ESTIMATED TOTAL PROJECT COST:	$151,300
GRANTEE'S SHARE:	$ 50,500
FEDERAL SHARE:	$ 50,000 [01]
(by year of project life)	$ 50,800 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To develop a regionalized program for solid waste disposal practices for a group of adjacent municipalities having a common problem of solid wastes handling, and to establish the administrative means for implementing the program developed.

PROCEDURES: Studies will be made to determine the quantity and characteristics of solid wastes produced in each municipality. Meteorological investigations will be made to determine the influence that incineration at potential sites might have on air pollution in the area. A thorough evaluation of various disposal methods will be made. Much of the work will be performed by the committee's engineering consultant, Mr. William T. Ingram, who will also provide over-all advisory services for the project.

PROGRESS TO DATE: Total solid waste production in the four cities is estimated at 9.26 lb per capita per day, based on field sampling studies, and data obtained during field visits to waste sources. This includes municipal, industrial, demolition and construction wastes, and also wastes resulting from periodic clean-up and street sweeping activities. Estimates for each of these are shown below:

Type Waste	*Estimated production (lb/cap/day)*
Municipal	2.61
Industrial	3.31
Construction	0.44
Demolition	2.03
Clean-up	0.31
Street sweepings	0.56

On this basis the solid wastes generated in Quad-City communities will average between 1,400 and 1,500 tons per day.

Alternative methodologies for solid waste disposal have been investigated. Incineration, sanitary landfill, composting, compaction, long distance rail haul, high temperature combustion, grinding, and salvaging were considered. Three primary methodologies are under intensive investigation, with the thought that these will provide, alone or in combination, a disposal system meeting the needs of the Quad-City complex. These are: (1) high temperature combustion; (2) long haul with transfer stations and sanitary landfill (3) incineration with sanitary landfill.

Sixteen possible locations for treatment and/or disposal of the study area's solid wastes have been considered and nine have been investigated in some detail. Ultimate investigation of sites is contingent on the methodology finally selected by the committee.

Legislation for the creation of a Solid Waste Disposal Authority, to administer a solid waste disposal system for the Quad-City area, has been introduced into the State Legislature.

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* Composed of representatives of the communities of Paterson, Passaic, Clifton, and Wayne, New Jersey.

Solid waste disposal incinerator prototypes for specialized operations

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PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00029

GRANTEE: City of Bridgeport, Connecticut, Lyon Terrace, Bridgeport, Conn. 06604

PROJECT DIRECTOR: Edward F. Bannon, Assistant Chief, 274 Middle Street, Bridgeport, Connecticut 06603

ESTIMATED TOTAL PROJECT COST: $290,012

GRANTEE'S SHARE: $ 96,670

FEDERAL SHARE: $181,671 [01]

(by year of project life) $ 11,671 [02]

DATE PROJECT STARTED: Dec. 1, 1966 **DATE PROJECT ENDS.** April 30, 1969

OBJECTIVES: To demonstrate the feasibility and economic practicability of disposal of bulky solid wastes by means of an improved incineration process and to demonstrate the safety of equipment and techniques involved.

PROCEDURES: The city will construct a large brick incinerator approximately 15 feet wide and 75 feet long of the type commonly referred to as the "Detroit" brush burner for disposal of all types of bulky combustible solid wastes. Facilities will be provided for the recirculation of hot flue gases to the primary combustion chamber to determine if this will reduce burning time and improve stack effluent quality. On completion of construction, a test program will be conducted to evaluate performance characteristics of the incinerator.

The firm of Leonard C. Mandell, Associates, Providence, R. I., will provide consulting engineering services in connection with the design and construction of the project and will plan and conduct the testing program with the assistance of the University of Bridegport's Engineering Department.

PROGRESS TO DATE: The project has been delayed due to a change in site for the proposed incinerator. Contracts have been executed between the city and the consulting engineer, and between the city and the University of Bridgeport. The consultant is proceeding with the design of the incinerator. It is expected that the facility will be constructed and ready for operation by the end of February, 1968.

Gainesville compost plant

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00030

GRANTEE: Gainesville Municipal Waste Conversion Authority

PROJECT DIRECTOR: Herbert W. Houston, Gainesville Municipal Waste Conversion Authority, 1600 S.E. 13th Road, P.O. Box 1152, Gainesville, Florida 32601

ESTIMATED TOTAL PROJECT COST:	$1,491,255
GRANTEE'S SHARE:	$ 497,322
FEDERAL SHARE:	$ 250,000 [01]
(by year of project life)	$ 625,000 [02]
	$ 118,933 [03]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** December 31, 1968

OBJECTIVES: To demonstrate the reliability, suitability, economic feasibility, and sanitary and nuisance-free operation of a recently developed high-rate, mechanical composting system for the disposal of municipal refuse from a medium sized community.

PROCEDURES: A compost plant designed to process 20 tons of refuse per hour will be constructed to dispose of municipal refuse from the City of Gainesville, the University of Florida, and Alachua County. Facilities will be provided for incorporation of either raw or digested sewage sludge into the compost. The plant will utilize the Metropolitan Waste Conversion System previously used at Largo, Florida and currently in use at Houston, Texas.

Records will be kept of the amounts of refuse and sludge processed, compost produced, salvaged materials and other noncompostable components. A complete cost analysis of the operation will be developed, including operation and maintenance costs of major items of equipment. The efficiency of the equipment will be evaluated, and operating characteristics and maintenance requirements determined. Necessary insect and rodent control measures will be instituted. Health records of employees will be maintained. Biological, bacteriological, and chemical and physical characteristics of the raw, partially digested, and finished compost will be determined.

Overall mechanical design criteria for the plant will be developed by the Metropolitan Waste Conversion Corporation, Wheaton, Illinois. Plant design and associated consulting engineering services will be provided by the firm of Reynolds, Smith and Hills, Jacksonville, Florida. Technical and scientific evaluation of the project will be planned and supervised by Environmental Engineering, Inc., Gainesville, Florida.

PROGRESS TO DATE: The project is several months behind schedule because of delays encountered during construction, due mainly to strikes and excessive rains.

Construction of the plant is basically completed, and a limited quantity of refuse has been processed in connection with plant start-up. It is anticipated that by the Spring of 1968 all of the "bugs" will have been eliminated from the process, and the plant will be operating at its full capacity of 150 tons per day.

The plant laboratory has been completed, equipment is being installed, and laboratory procedures for plant and compost evaluation are being developed. To establish base-line data Environmental Engineering, Inc., is investigating the coliform content of some commercially-available organic fertilizers. Results obtained from the initial analyses are reported as follows:

Types of fertilizer	*Number of samples*	*Geometric mean coliform content MPN/gm (dried wt)*		
		Presumptive	*Confirmed*	*Completed*
Compost No. 1	10	1.25	0	0
Compost No. 2	10	1.69	0	0
Dried Digested Sewage Sludge	6	0	0	0
Dried Cow Manure	7	41.5	9.1	6.2
Digested Cow Manure	11	2805.	13.9	7.3

The dried digested sewage sludge showed no evidence of coliform, while only the presumptive test was positive for the two composts tested. Both cow manures contained large quantities of coliforms, although the dried manure apparently contained somewhat fewer of these organisms.

A brief description of the process employed at this plant follows: Incoming refuse is weighed, deposited in a receiving hopper, and is conveyed to the picking table by a conveyor system which loosens the material, making it easier to separate. The pickers remove cardboard, paper, metal, rags, and bulky items, all of which, except the latter, are sold as salvage. The refuse is then ground in a Centriblast Disintegrator from which it is discharged to a ballistic separator which removes the heavier materials (metals), and lighter materials (paper and plastics). The remaining material receives a second grinding in a Williams Hammermill. Sewage sludge and/or water can be added at the discharge end of this grinder. The material is mixed by screws and remaining ferrous material removed by a magnetic separator. Two digestor tanks, each 320 feet long by 20 feet wide, are provided, in which the mixed material is biologically degraded into a stable compost. The digestors provide six days detention time at plant design capacity. These tanks have perforated bottoms, through which air is periodically passed during the digestion period. Tank contents are mixed by an agitator once every three days.

Following digestion the compost is reground in two specially built rasps and stockpiled.

San Jose/Santa Clara County solid waste disposal demonstration project

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00033

GRANTEE: City of San Jose, City Hall, 801 North First Street, San Jose, California 95110

PROJECT DIRECTOR: Raymond C. Miller, M.D., Director of Public Health, City of San Jose, San Jose, California 95110

ESTIMATED TOTAL PROJECT COST:	$186,000
GRANTEE'S SHARE:	$ 62,000
FEDERAL SHARE:	$ 39,000 [01]
(by year of project life)	$ 85,000 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** December 31, 1967

OBJECTIVE: To develop a plan, using a systems analysis approach, for handling all solid wastes generated in the San Jose Metropolitan Area and Santa Clara County.

PROCEDURES: The FMC Machinery/Systems Group, FMC Corporation, Santa Clara, California, will carry out a systems analysis for the study area which will encompass three major activities: 1) Determination of the solid waste situation in San Jose and all of Santa Clara County. 2) Examination of salvage and by-product markets and the various processes by which these products can be obtained. 3) Determination of functional specifications for disposal demonstration facility for the San Jose Metropolitan Area and disposal requirements for all of Santa Clara County.

Concurrently with the above, there will be undertaken a systems analysis of the legal, political and social aspects for full plan development.

PROGRESS TO DATE: Surveys of solid waste generation, collection and disposal in the study area have been completed. A coordinated information collection and exchange effort was developed between FMC, the California Department of Health, and the University of California, each of which possessed mutually useful information concerning various aspects of the solid wastes problem in the study area.

The final report of the study is being prepared. The project is approximately three months behind schedule, and completion of the final report is expected by April 1968.

Erie County refuse disposal project

PROJECT TYPE: Study & Investigation **GRANT NO. D01-UI-00035**

GRANTEE: Erie County Department of Health

PROJECT DIRECTOR: Thomas C. West, Director, Division of Environmental Health, Erie County Department of Health, 606 West 2nd Street, Erie, Pennsylvania 16502

ESTIMATED TOTAL PROJECT COST:	$47,842
GRANTEE'S SHARE:	$18,511
FEDERAL SHARE:	$22,665 [01]
(by year of project life)	$ 6,666 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1969

OBJECTIVES: (1) To identify and evaluate the separate solid waste collection and disposal systems now being operated in Erie County and to develop a proposed county-wide system for solid wastes handling. (2) To study the sociological problems associated with the proposed establishment of refuse disposal sites and to develop and implement a program to overcome adverse public attitudes.

PROCEDURES: The consulting engineering firm of Michael Baker, Jr., Inc., Rochester, Pennsylvania, will provide the necessary services to accomplish the first project objective. The present solid waste disposal practices of the county's political subdivisions will be determined. Several alternative disposal methods for a county-wide disposal system will be considered, and possible disposal sites located. The possibility of integrating existing systems, or portions thereof, into the proposed county wide system, will be considered. Capital and annual operating costs for the recommended system will be estimated. Proposed methods of financing and administration will be presented.

The County Department of Health will develop and implement a public information program in connection with the second project objective.

PROGRESS TO DATE: All of the field work required to develop a proposed county-wide solid waste disposal plan has been completed, and the consultant's final report is being prepared. Major conclusions and recommendations developed by the consultant at this time are as follows:

1. Existing solid waste disposal practices within the county are completely inadequate and incapable of serving the county over a long-term period. There is an immediate need for additional solid waste disposal facilities in the county to cope with the current and future needs of an expanding population and with an ever-increasing volume of solid waste. A centralized or county-wide approach to the solid waste problem is the only logical solution since independent and/or separate actions by individual municipalities, if attempted, would only result in prohibitive and unrealistic costs for solid waste disposal in many county areas.

2. The investigations have absolutely ruled out the practicality of utilizing sanitary landfill exclusively as a long-term solution to the county solid waste disposal problem due primarily to the lack of suitable large land tracts required for this method of solid waste disposal. Incineration of solid wastes in conjunction with landfill of the incinerator residue is proposed as the major method of solid waste disposal for the Erie County area. The proposed facility would be the economical regional solution to the solid waste disposal problems of the county's more than 250,000 people.

3. The county should undertake a phased course of action in accordance with the following schedule: (a) Acquisition or reservation of large land areas for solid waste disposal purposes around the county's urban areas, and acquisition of the site for the proposed incinerator. (b) Continued efficient use of existing landfill sites and acquisition of additional suitable land-

fill sites of sufficient area to provide for satisfactory disposal of county refuse up to 1971 at which time the proposed incinerator may be in operation. (c) Investigation by the City of Erie of the practicality of increasing the burning capacity at its existing incinerators, so as to reduce the volume of wastes now being landfilled. (d) Construction of the proposed county incinerator facility. (e) Closure of existing dumps and landfills, except for disposal of non-combustible wastes. Landfills serving county population centers beyond economical haul distances to the incinerator should be retained. (f) Continuation of current area collection practice employing local municipal and/or private collectors or continuation of both. However, collection practices should be standardized throughout the county by proper collective and legislative action of all participating political subdivisions. (g) Following construction of the new incinerator, abandonment of the existing Erie garbage incinerator, and continued operation but eventual phasing out of the Erie West Side trash incinerator.

The county has formed a solid waste advisory committee to review the recommendations of the consulting engineer and to initiate a public education program. The committee has conducted an active program to date. Television, radio and newspaper releases have been used to inform the public as to the county's solid waste problems. Numerous talks have been given to civic clubs, and exhibits have been shown to further make the public aware of the problem. A questionnaire survey of a random sampling of the county's population indicated that incineration is the best known means of solid waste disposal (91.2 percent of the people questioned knew what incineration was), sanitary landfill was the second (46.8 percent knew what sanitary landfill was), and composting was next (35 percent knew what composting was). The survey also indicated that 93.5 percent of the people would support the governmental officials in their effort to solve the garbage and refuse problems in Erie County. The educational program is continuing, guided by the results of the questionnaire.

Oklahoma County solid waste disposal study

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00036

GRANTEE: Oklahoma City—County Health Department

PROJECT DIRECTOR: D. C. Cleveland, Director, Division of Environmental Health, City-County Health Department, 331 West Main Street, Oklahoma City, Oklahoma 73102

ESTIMATED TOTAL PROJECT COST:	$70,830
GRANTEE'S SHARE:	$23,609
FEDERAL SHARE:	$13,767 [01]
(by year of project life)	$19,687 [02]
	$13,767 [03]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1969

OBJECTIVES: To prepare a long-range plan for the collection and disposal of solid wastes to best serve the needs of Oklahoma County. To promote necessary legislation for the establishment of an area-wide solid wastes collection and disposal district.

PROCEDURES: The project will be conducted by staff members of the Oklahoma City-County Health Department. Consulting engineering services will be provided by Professor Raul Zaltzman, University of West Virginia.

The records of each municipality will be examined to determine the area served by the collection system, ownership of the system, cost and frequency of collection, and amount and character of wastes collected. Costs of extending existing systems to serve all municipal and rural population will be estimated. Advantages of an area-wide collection system vs. individually operated systems will be compared.

A survey of existing disposal sites will be made to determine ownership, amount and character of wastes received, cost and effectiveness of operation.

Commercial, industrial, and salvage operations will be surveyed to determine the amount, character, and method of disposal of solid wastes they produce.

A plan will be developed for the most effective solid waste collection and disposal system to serve the needs of the County. If it appears that an area-wide system or systems can be economically organized and operated, necessary legislation will be promoted to permit operations on this basis.

PROGRESS TO DATE: Existing solid waste collection and disposal facilities have been surveyed. Collection systems range from very sophisticated and efficient types in the larger cities to no service at all in the smaller communities. Pickup frequency varies from twice weekly to once a month. Disposal is mainly by open dumps or improperly operated landfills. Open burning is practiced at most disposal sites, and at many homes, businesses, and schools. Burning operations are properly controlled in only a few instances, resulting in hazardous fires at many locations during dry seasons. Many private haulers are operating, the great majority being unlicensed.

At present, production of solid wastes in the County is estimated as being 440,000 tons per year, which is approximately 100,000 tons per year more than in 1960. Projections indicate that by 1985 this rate will increase to over 700,000 tons per year.

A mathematical model has been designed to study and optimize the operational characteristics of all the factors involved in the operation of an area-wide solid waste storage, collection, and disposal system.

Various methods of solid waste disposal have been investigated. Sanitary landfill appears to be the most feasible. Several proposed landfill sites have been selected.

Incinerator no. 5. Phase I—special studies. Phase II—design

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00038

GRANTEE: Department of Sanitary Engineering, Government of the District of Columbia

PROJECT DIRECTOR: William F. Young, Chief, Project Development & Engineering Branch, Department of Sanitary Engineering, Government of the District of Columbia, 14th & E Streets, N. W., Washington, D.C. 20004

ESTIMATED TOTAL PROJECT COST:	$484,284
GRANTEE'S SHARE:	$161,428
FEDERAL SHARE:	$ 62,802 [01]
(by year of project life)	$260,054 [02]

DATE PROJECT STARTED: June 1, 1966 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES:

I. To determine the feasibility of incorporating special features into the design of a proposed 800 ton per day incinerator in order to provide facilities for performing demonstration and research projects related to advancing the science of solid waste disposal, reducing air pollution, improving plant operation and establishing parameters for design and operation of future incinerator installations and allied equipment.

II. To study, investigate, and develop a design for a solid waste incinerator installation, together with satellite equipment capable of reducing the volume of all categories of combustible solid wastes for disposal in sanitary landfills.

Phase I—special studies

PROCEDURES: Six separate studies will be conducted for the proposed incinerator by Day & Zimmerman, Engineers and Architects, Philadelphia, Pennsylvania, as follows:

Study of municipal incinerator effluent gases. The effect of certain incinerator variables on the type and quantity of effluent gas emissions and their effect on emission control equipment will be studied. The performance of various available types of emission control equipment will be evaluated. Estimated capital and operating costs for the acceptable types of emission control equipment for the proposed incinerator will be developed.

Heat recovery. Fuel characteristics of refuse and combustion air requirements based on fuel analysis will be investigated. Relative characteristics of waste heat recovery boilers will be examined. Estimates will be made of capital and operating costs for each type of boiler, and for a conventional incinerator without waste-heat equipment so that incremental cost additions may be determined.

Metal recovery. Recovery of metal before incineration will be considered. Suitable procedures for processing furnace residue to separate ferrous metals will be reviewed. Capital and operating costs will be estimated for a metal recovery facility sized to process residue from the proposed incinerator.

Control laboratory. The various types of laboratory and monitoring equipment available and appropriate to perform the desired physical and chemical analyses and continuous recording of plant operating conditions will be studied. Estimates of capital costs and space requirements for recommended items will be made.

Size reduction of oversize burnable waste. Various types of equipment available for size reduction of large combustible materials will be studied. Capital and operating costs for a recommended installation will be estimated.

Size reduction of bulky metal objects by compression presses. Types and capacities of presses available for the reduction of bulk volume of noncombustibles will be investigated. Capital and operating costs for a compression press installation will be estimated.

PROGRESS TO DATE: The foregoing studies were completed during the first year of the project and a final report prepared by the consultant. Pertinent features of each study are summarized below:

Study of municipal incinerator effluent gases. This report considers the significant characteristics of municipal incinerator effluent gases. A discussion of the chemical constituents of incinerator stack emissions is presented. The effluent gases were found to be organic and inorganic in nature in both gaseous and solid states. Some constituents were found to be toxic and corrosive when present in appreciable amounts. Various types of emission control equipment were evaluated, including electrostatic precipitators, air scrubbers, mechanical cyclones and baghouse filters. The electrostatic precipitators preceded by mechanical cyclone collectors were recommended because of their high efficiency and ability to meet stringent air pollution control standards. Although high energy scrubbers were considered acceptable from a performance standpoint and lower cost, aesthetic objections to the vapor plume and probable thermal pollution of the water source rule out their application at this location.

Heat recovery. Several apparently successful European applications of steam boilers to municipal refuse incinerators have prompted consideration of similar installations for American incinerators. American operating experience with incinerator heat recovery boilers has been limited, and no outstanding pattern of successful operation has been established.

In order to evaluate this disparity between European and American practice a comparison is made of typical refuse compositions, refuse heating values and the applications of heat recovery equipment to incinerator furnaces.

Consideration is given to both refractory and water-cooled furnaces, their effect on excess air requirements and the economics of the sale of steam or other methods of heat dissipation.

For the proposed Incinerator the application of a boiler plant capable of burning 800 tons of refuse per day with four incinerator furnaces is considered. The economics of the proposed plant do not justify the installation of heat recovery equipment.

Can-metal recovery. This study reviews the possibilities of recovering ferrous metal from municipal refuse either before or after incineration. The study indicates that the only major existing market for this material (after incineration) is the copper mining industry. This market is currently being satisfied.

The capital investment required and the operating costs to be expected for an installation to recover ferrous can metal from the residue of a new 800 tons per day incinerator have been estimated. Because of the low price obtainable for recovered can metal and the high cost of freight to the one sizable market, it is concluded that facilities of this type should not be included in the new District of Columbia incinerator project.

Control laboratory. This report itemizes instrumentation and laboratory equipment and their estimated installed costs. The equipment was selected to permit normal monitoring of plant operations and to aid in the performance of tests for development of incinerator design and operating techniques. Equipment was grouped into four categories: Recording and indicating equipment for incinerator operation; Physical laboratory equipment; Chemical laboratory equipment; and Monitoring equipment for test and development studies. The total cost of recommended equipment and space is estimated at $447,675.

References to existing test procedures are presented to aid in the proper application of the equipment items suggested.

Size reduction of oversize burnable waste. This report considers various methods of size reduction of oversize burnable waste including the use of specially designed incinerators and shredders.

A shredder of the hammermill type is recommended for installation at the proposed new incinerator site. Also recommended is a metal separator, as passage of excess metal through the furnace is not desirable. The installation cost is estimated to be approximately $667,000 and annual operating costs are estimated to be $125,000.

Size reduction of bulky metal objects by compression presses. This report discusses methods for municipal disposal of bulky metal objects. The use of compression presses to reduce the volume of these objects was investigated and found to be acceptable under certain conditions. Capital investment estimates and evaluation of operating costs for metal presses installed at two separate locations are reported. The amount of metal to be handled in the District of Columbia is not sufficient to achieve a good economy of operation. The alternative use of outside contractors or metal shredding as a potentially more economical solution is recommended.

Phase II—design

PROCEDURES: The consulting engineering firm of Day & Zimmerman Associates, Philadelphia, Pennsylvania, will make a comprehensive investigation of the design features, and design a continuous feed incinerator and appurtenances. Investigations will be conducted to determine the performance of special equipment (e.g. mechanical collectors and electrostatic precipitators) and to develop design modifications which will make them suitable for use in municipal solid waste incineration. Size reduction of large combustible objects by a large hammermill will be investigated, and, if proven feasible, will be incorporated into the design. Special control and research laboratory facilities will also be included in the design of the incinerator so that a thorough evaluation can be made of the refuse incinerator while operating under all conditions. Included in the study will be an investigation of procedures and actions which a municipality must take for interim disposal of solid wastes during design and construction of a permanent facility. The design of this incinerator also will demonstrate how to incorporate a single jurisdiction's solid waste facility into a long range regional plan.

PROGRESS TO DATE: Design of the incinerator is proceeding, and the project is expected to be completed on schedule.

Maricopa county-wide solid waste disposal

PROJECT TYPE: Study & Investigation **GRANT NO.** D01–UI–00039

GRANTEE: Maricopa County Health Department

PROJECT DIRECTOR: Joseph J. Weinstein, M.C.E., Director, Division Environmental Health Services, Maricopa County Health Department, 1825 E. Roosevelt, Phoenix, Arizona 85006

ESTIMATED TOTAL PROJECT COST: $87,000
GRANTEE'S SHARE: $29,000
FEDERAL SHARE: $30,000 [01]
(by year of project life) $14,000 [02]
$14,000 [03]

DATE PROJECT STARTED: December 1, 1966 **DATE PROJECT ENDS:** March 31, 1970

OBJECTIVES: To develop a solid waste disposal system and plan for county-wide reference and use, and to develop a protocol and timetable for putting the plan into effect.

PROCEDURES: Types and quantities of solid wastes now being produced in the county will be determined, and existing disposal methods identified. The interrelationship between current collection practices and disposal practices will be studied. Estimates of population growth to the year 2000, and parallel projected increases in solid waste production will be made. An analysis will be made of possible solutions to the solid waste disposal problems of the county. A recommended county-wide solid waste disposal plan will be developed. This will take into account necessary funding arrangements, recognize and recommend required modifications of law, and describe needed intergovernmental cooperative agreements and other methodology which will assure a feasible plan.

The firm of John Carollo Engineers, Phoenix, Arizona, will provide consulting engineering services and be responsible for attaining a majority of the project objectives. Engineering and other personnel of the County Health Department will make supplementary surveys of the availability and suitability of certain land for landfill purposes, and conduct topographic and soil exploration studies as needed.

PROGRESS TO DATE: A report of the first year's work is about 95 percent complete. The report is organized into six sections, as follows:

Section	*Title*	*Status*
1	Introduction	Complete
2	Current solid waste disposal methods	99 Percent
3	Population growth	Complete
4	Solid wastes disposal operations in Maricopa County	99 Percent
5	Analysis of solid wastes disposal operations in Maricopa County	95 Percent
6	A Maricopa County solid wastes disposal plan	50 Percent

The general study included research into historical and current technical literature on solid wastes disposal methods and records; visits to major disposal sites in Texas and California including composting plants, incinerator plants, and sanitary landfill operations; and attendance at the 1967 American Public Works Association Congress and Equipment Show. Written and photographic records were accumulated for all municipal disposal operations in Maricopa County. Conferences were held with public works directors and engineers who are concerned with disposal operations in the County. Some special tests were made by cities to determine valid density relations to be used in planning.

Detail maps, tables, and graphs were produced for inclusion in the report. The report is substantially complete except for the disposal plan. Centroids of future solid wastes production have been estimated, disposal sites are being reviewed, and the plan study has progressed through major decisions.

Completion of the report by March 1, 1968, is forecast. All items in the scope of work have been studied and are included in the report.

Preliminary findings suggest that the best county-wide disposal system would consist of a transfer operation, with ultimate disposal at abandoned mines. It is proposed to further explore and refine this concept during the second year of the project and work out the design elements of such a disposal system. The third year would then be devoted to implementing and testing the proposed system.

Solid waste disposal by incineration, using an incinerator with characteristics requiring minimum control equipment

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00040

GRANTEE: City and County of San Francisco, Department of Public Works, Room 260, City Hall, San Francisco, California 94102

PROJECT DIRECTOR: Clifford J. Geertz, City Engineer, Room 359, City Hall, San Francisco, California 94102

ESTIMATED TOTAL PROJECT COST:	$644,870
GRANTEE'S SHARE:	$214,956
FEDERAL SHARE:	$117,193 [01]
(by year of project life)	$155,527 [02]
	$157,194 [03]

DATE PROJECT STARTED: April 1, 1967 **DATE PROJECT ENDS:** March 31, 1970

OBJECTIVES: Develop, design and construct a municipal type refuse incinerator with operating characteristics that would meet the requirements of the several air pollution control districts in the Pacific Coastal area with a minimum of control equipment.

PROCEDURES: The project will be conducted by the technical staffs of the Department of Public Works of the City and County of San Francisco, and the Bay Area Air Pollution Control District. Technical advice and assistance will be furnished by the consulting firm of Garretson–Elmendorf–Klein–Reibin, Architects and Engineers, San Francisco, California.

Incineration process features which will be studied, developed, fabricated and tested include; 1) a mechanical grate capable of functioning with a minimum of underfire air; 2) multiple chamber furnace without conventional bridge and/or curtain wall; 3) a secondary chamber located so as to obtain turbulence and complete burnout of gases; 4) air jets for inducing turbulence and mixing at the entrance to the secondary chamber; and 5) a fly ash scrubber, which, when used in conjunction with the other components, would produce an effluent capable of meeting air pollution regulations. Design factors will be evaluated by testing under varying conditions of operation. Construction, maintenance and operating cost information will be developed for a unit capable of handling 100 to 150 tons per day.

PROGRESS TO DATE: The City has entered into a contract with Garretson-Elmendorf-Klein-Reibin, Architects and Engineers, to supplement the technical staffs of the Bureau of Engineering of the City and County of San Francisco and of the Bay Area Air Pollution Control Districts in carrying out this project. The City has drafted a preliminary copy of a contract for the engineering and design of the grates and prepared a preliminary set of plans of the incinerator layout.

A member of the City's engineering staff has completed a tour of several municipal incinerator installations to observe present incineration practices, so that any outstanding features would be incorporated into the design of the proposed incinerator.

Building an amphitheater and coasting ramp with municipal refuse

PROJECT TYPE: Demonstration **GRANT NO.** D01-UI-00045

GRANTEE: City of Virginia Beach, Virginia

PROJECT DIRECTOR: Charles S. Kiley, Director of Public Works, 18th and Artic Avenue, Virginia Beach, Virginia

ESTIMATED TOTAL PROJECT COST:	$384,424
GRANTEE'S SHARE:	$128,142
FEDERAL SHARE:	$147,219 [01]
(by year of project life)	$ 52,436 [02]
	$ 56,627 [03]

DATE PROJECT STARTED: Jan. 1, 1967 **DATE PROJECT ENDS:** Dec. 31, 1969

OBJECTIVES: To demonstrate the feasibility of constructing an above-grade sanitary landfill with municipal refuse, to serve as an amphitheater and coasting ramp.

PROCEDURES: Consulting services and assistance are being provided by the Old Dominion College, School of Engineering, and the State Health Department.

The project site area will be thoroughly surveyed and prepared. The land where the fill is to be placed will be excavated to a depth somewhat above ground water and a standard sanitary landfill will be started. Refuse will be placed, compacted, and covered each day with a 6-inch layer of earth. When earth from the original cut is used up, earth from a borrow pit will be utilized. When the project is completed, this pit will be allowed to fill with water to form a lake. Top soil will be piled separately for use as a final cover material. This material will be placed on the side slopes and covered with vegetation as the fill rises. Commencing with this project, a nursery will be started to grow plants which will be used to stabilize the banks. The fill will be constructed so that at completion an amphitheater and coasting ramp will be created. This project has been designed to dispose of the refuse from a city of about 150,000 population for a three-year period.

PROGRESS TO DATE: The project is in its second year and is approximately 20 percent complete.

The base of the hill has been staked out and divided into quarters, one of which is worked at a time. Three-quarters of the base area has been built up with compacted refuse and cover material to a height of nine feet. This is five feet above the original ground surface, since prior to filling the base was excavated to a depth of four feet. It is planned to build the hill up to a total height of some 60 feet.

Since April 1, 1967, all refuse from Virginia Beach (estimated population 150,000) has been placed in the hill. An FWD Wagner Compactor is used to spread and compact refuse. Cover material is excavated by a ¾-yard dragline and is delivered and dumped on the working face by two dump trucks. A bulldozer is being used as standby equipment when the compactor is down for repairs. Work is proceeding on a six day per week schedule. An estimated 240 tons/day of refuse has been received. In December 1967, a scale was placed in operation and the estimated weight will be reassessed based on actual weights obtained over a period of time.

Old Dominion College is carefully studying and monitoring the project. To date five wells have been sunk adjacent to the hill to determine the effect, if any, of leaching into ground water. Random sampling of refuse is underway to determine nature of material being deposited in the mound. Settling plates have been designed and will be installed shortly to monitor settlement under the fill. Gas probes and thermalcouples will be inserted into the hollow perforated rods of the settling plates to monitor gas and heat production within the mound. Cross sections are also being run to determine average fill versus in-place volumes over two and four week periods.

Delays in procurement of equipment, equipment breakdown and adverse weather have slowed progress. It is difficult at this point to determine whether the project will be completed on schedule.

Development of construction and use criteria for sanitary landfills

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00046

GRANTEE: County of Los Angeles, Hall of Administration, 500 West Temple Street, Los Angeles, California 90012

PROJECT DIRECTOR: John A. Lambie, County Engineer, County Engineering Building, 108 West Second Street, Los Angeles, California 90012

ESTIMATED TOTAL PROJECT COST:	$303,500
GRANTEE'S SHARE:	$101,270
FEDERAL SHARE:	$ 66,330 [01]
(by year of project life)	$ 73,300 [02]
	$ 62,600 [03]

DATE PROJECT STARTED: Jan. 1, 1967 **DATE PROJECT ENDS:** Dec. 31, 1969

OBJECTIVES: (1) The development of methods to control gas movements from existing and new landfills; (2) the development of methods to control leachate discharging from existing and new landfills; and (3) the development of a "Code" for use in controlling construction of buildings on completed sanitary landfills.

PROCEDURES: The actual investigations will be made jointly by Engineering-Science, Inc., Arcadia, California, and the County's Technical Staff.

First year. Provide solutions to the problem of decomposition gas movement from sanitary landfills into surrounding soil and groundwaters. These solutions will be the result of studies of: gas flow measurements, geologic configurations, soil properties, subsidence rates, and gas control devices. *Second year.* Continue to investigate subsidence in sanitary landfills. The investigations will include (1) a review of subsidence data obtained from other on-going solid waste disposal projects; (2) surveys of existing structures located on landfills in Los Angeles and San Francisco areas; (3) evaluation of settlement data; (4) studies of the effects of settlement on structures, utilities, and roadbeds; and (5) recommendation for construction of above facilities on sanitary landfill sites. *Third year.* The findings from the first and second years will be combined and evaluated to provide specific design and construction guidelines for sanitary landfills in urbanized areas. Solutions to subsidence problems will be developed, pilot experiments to demonstrate the advantages of volume reduction prior to landfilling will be conducted, salvage of materials will be studied, and a control and inspection system for landfill operations will be formulated. Throughout the study, specific proposals for demonstration projects will be formulated.

PROGRESS TO DATE: An interim progress report, covering the work performed during the first year of the project (January 1–December 31, 1967) has been prepared by the grantee. The following material has been taken from this report:

Summary

During the first-year program a comprehensive study of gas movement from sanitary landfills was undertaken. Eight sanitary landfills were selected in the Los Angeles area and general soil and geologic information was obtained for these landfills. A total of 363 shallow gas probes, 2 feet deep, and 10 deep gas probes, 8 feet deep, were installed around these landfills. Two sets of samples were obtained and analyzed from these probes. Using the results of these samples contours of equal methane and carbon dioxide concentration were plotted around each landfill. Correlations were developed between the pattern and extent of gas movement and the nature of soil formations, the topography and the effect of existing gas control devices.

Laboratory experiments were conducted to test the suitability of natural soils for gas barrier membranes. Five soils with different particle size distributions were tested in laboratory diffusion columns at three levels of moisture content and three inflow gas pressure conditions. Using an analytical solution for the differential equation governing the flow of gases through porous media diffusion-dispersion coefficients for each soil were determined. These data provide a basis for calculating the rate of flow of gases through these soils under different conditions of soil moisture and gas pressure. This in turn provides a basis for determining the relative degree of effectiveness of these soils as gas barrier membranes.

Field experiments on gas barrier and control devices were also undertaken. These experiments encompassed the implementation of gas control systems at two of the sites in the Los Angeles area. One of these systems consists of perforated pipes installed directly on the sloping walls of an unfinished landfill, and the other involves excavation of 60 foot deep wells 125 feet from a finished landfill. The deep well system will operate on the basis of combined gas suction and air flushing.

In addition, survey monuments were established at four selected sites and background data was collated on land subsidence in sanitary landfills. Information on the existing practices in sanitary landfilling, and various land uses on completed landfills was also collected. These data will form the initial input for the second-year program which will encompass the study of subsidence and development of use criteria for completed landfills. A study plan for the second-year project was developed and was submitted separately with the grant continuation application.

Most of the work conducted on this project prior to 15 November 1967 are discussed in this draft of the final report. A more comprehensive account of all aspects of the first year-study will be presented in the final report for the first-year project.

Conclusions

1. Gases generated in a sanitary landfill, which consist predominantly of methane and carbon dioxide, can travel a considerable distance from the fill depending on the nature of the soil formations around the fill. At the eight landfills selected for this study methane concentrations of 10 percent were detected at a distance of 600 to 700 feet from the fill at site no. 1 and 600 feet from the fill at site no. 8. Both of these landfills were constructed in depressions resulting from gravel mining operations. The natural soils around these fills consist of coarse materials and are classified as gravelly sand. On the other hand at landfill site no. 6 where the soil formations consist predominantly of fine materials such as silt and clay only negligible methane concentrations were detected with shallow probes at a distance of 200 feet from the fill.

2. Gas movement from sanitary landfills takes place by molecular diffusion and connective gas transport mechanisms. Positive gas pressures of 2 to 3 inches of water have been registered in or adjacent to sanitary landfills. Positive pressure in the fill causes the connective transport of gases through the soil around the fill. The rate of this transfer is determined by the permeability characteristics of the soil formations around the fill. In other words different flow rates may result under identical pressure and concentrations from two landfills one in a gravel pit and another in a tight soil formation. However, the slower rate of flow from a landfill in finer soil formations may result in excessive buildup of pressure and concentration which will in turn result in an increased rate of flow through the same soil. In order to calculate the rate of flow of gases from sanitary landfills coefficients of diffusion-dispersion for various natural soils are being determined in the laboratory under various conditions of connective movement through the porous media. (This work is still in progress and the results will be reported in the final report for this study.)

3. Gas movement from sanitary landfills may present serious fire and explosion hazards to the neighboring areas and to the buildings located on the landfill. In order to alleviate these problems, where they are shown to exist by gas monitoring, two steps should be taken: (a) Gas control systems should be developed for the existing landfills. These controls systems will vary with the nature of the fill, the soil formations around the fill, and the economics of the control system. In a coarse gravelly area the best system may consist of a gas barrier membrane whereas

in clay or silty soils a gravel filled trench may provide adequate control for gas movement. (b) Adequate venting should be provided for all building on or near the landfill such that explosive gases are not trapped and accumulated in the building.

4. The uniform building code requires updating to include adequate protection against fire and explosion in structures located in the vicinity of refuse fills.

5. Gas control measures, as required should be built into refuse fills at the time of their construction and future land use of surrounding areas should be established prior to the issuance of refuse fill permits.

6. The county or agency that issues building permits should require an engineering report by an engineer experienced in gas movement from a refuse fill, for buildings located near or on refuse fills. The report should indicate the safety of the site for the particular use being made and the owner should assume liability for any gas hazard that could occur in the structure from refuse-produced gas before a permit is issued.

7. Temporary buildings and structures housing personnel should not be located on or within 500 feet of refuse fills of significant volume constructed in fine textured soils without thorough investigation of the gas hazards. If gas movement into the adjacent areas is likely due to high gas permeability in the soil strate around the fill area, then the zone of investigation should be extended to 1,000 feet outside the fill margin.

8. The effectiveness of a gas control system for each refuse fill of significant size should be evaluated by an engineer experienced in refuse-produced gas migration. This service includes those sites where natural conditions appear to be favorable for refuse fill construction and those cities where import material for gas barrier, gas relief systems and odor control is required.

Use of abandoned strip mines for solid waste disposal in Maryland

PROJECT TYPE: Demonstration **GRANT NO. D01-UI-00048**

GRANTEE: Maryland State Department of Health

PROJECT DIRECTOR: Wilfred H. Shields, Jr., Acting Chief, Division of Solid Wastes, Maryland State Department of Health, 301 West Preston Street, Baltimore, Maryland 21201

ESTIMATED TOTAL PROJECT COST: $191,320
GRANTEE'S SHARE: $ 65,002
FEDERAL SHARE: $ 28,597 [01]
(by year of project life) $ 50,352 [02]
$ 47,369 [03]

DATE PROJECT STARTED: Nov. 1, 1966 **DATE PROJECT ENDS:** Oct. 31, 1969

OBJECTIVES: To demonstrate the feasibility of using abandoned strip mines for sanitary landfills.

PROCEDURES: The project will be conducted by personnel of the Division of Solid Wastes, Maryland State Department of Public Health, in cooperation with county and municipal governments.

An abandoned strip mine in Allegany County will be selected as a demonstration site for sanitary landfill operations. Information will be developed to identify the following: (a) procedures, equipment requirements, and desirable operational techniques for efficient year-round utilization of abandoned strip mines for solid waste disposal; (b) unit costs for disposal; (c) unit capacity of strip mine landfills.

A second abandoned mine will be selected and used for a sanitary landfill. Investigations at this site will be undertaken to determine any special precautions needed to prevent ground or surface water pollution caused by water leaking through the fill, and the effects of the landfill operations on acid production.

All abandoned strip mines in the State suitable for solid waste disposal will be located and their capacity estimated.

PROGRESS TO DATE: An abandoned strip mine near Frostburg, in Allegany County, was selected as the demonstration site for sanitary landfill operations. The mine is 1900 feet long, with an average width of 80 feet and an average depth of 42 feet. Prior to initiation of the project, State Health Department personnel had to spend considerable time in discussing and explaining the project with local citizens organizations and governing bodies, in an attempt to show that the project would be an advantage, rather than a detriment to the area. As a result of this activity a formal agreement was executed between Frostburg, Allegany County and the State Department of Health, specifying the responsibilities and privileges of each Agency in the construction and operation of the landfill, and providing for financial support of the project by the City and the county. Other required preliminary activities included securing approval for the landfill operation from the State Department of Water Resources and the State Bureau of Mines; development and institution of a sampling program to determine the effect, if any, of the landfill on adjacent ground waters; acquisition of equipment and operating personnel; site preparation, including removal of standing water, grading and bottom stabilization, and provision of storm water diversion ditches.

The landfill was opened to receive refuse on April 1, 1967. A D-4 bulldozer was provided for compacting and covering the refuse. Several months after the landfill was opened, a Thurman portable truck scale of 80,000 pounds capacity was installed, a data collection and recording system devised, and collection of pertinent data instituted. For each vehicle dumping at the site, information being collected includes: vehicle number and type, source and type of refuse, weight of refuse delivered to the landfill, time, date, and weather conditions. The landfill serves a population of some 16,000 people from the City of Frostburg and the surrounding Allegany County area. When the landfill was opened, the Allegany County Health Department instituted a campaign to eliminate all haphazard and illegal dumps in the surrounding areas. A concentrated radio, newspaper, and television campaign was undertaken to inform the public that the laws against haphazard dumping would be enforced, and that a sanitary landfill had been established in the area. As of November 1, 1967, 24 of the 87 dumps involved had been cleaned up, closed, and posted.

Since there is no refuse collection in many of the rural areas served by the landfill, many individuals haul their own refuse to the facility. It was found that this interfered with efficient operation of the landfill, and also resulted in an indeterminate quantity of refuse being brought in to the site. To eliminate problems, an intermediate receiving station for such solid wastes was provided immediately outside the landfill site. A dump truck was provided into which individuals could deposit their refuse at any time during the day or night, seven days a week. Since the site is closed from 4:30 P.M. to 8:30 A.M. during the week and all day Sunday, this also provided a disposal facility for persons arriving at the site during these times. At the end of each working day the truck's contents are weighed and placed in the fill. Records are kept of the number of vehicles utilizing this intermediate facility, by means of a vehicle trip counter.

A tentative estimated annual operating cost, based on the first five months' experience (April–August), is $1.40 per person. The State Department of Health feels that at least 8,000 more people could be served by the facility with no increase in this cost, thus reducing the per capita operating cost to less than $1.00. The possibility of servicing an additional nearby community of 33,000 population is being explored. It is anticipated that further operating experience will permit the development of a more refined cost estimate.

Annual rate of usage of available mine volume is tentatively estimated as being 9.3 acre-feet per 10,000 persons served, again based on the first five months of operation. The projected life of the strip mine at this rate is 9 years, 10 months assuming that the served population remains at 16,000. However, during the first few months of operation large quantities of earth were mixed with the refuse to help stabilize the bottom of the pit. Attempts are being made to reduce this usage rate to approximately 6 acre-feet per year by reducing the earth-refuse ratio.

A major objective of the second phase of this demonstration project is to determine if the utilization of abandoned strip mines for the disposal of solid wastes can reduce acid mine water drainage to surface streams. It has been found that in western Maryland acid mine drainage from strip mines results from surface runoff finding its way into the mine—a condition which is automatically eliminated by the proper design and construction of diversion ditches around the strip mine as part of this preparation for the receiving of solid waste materials.

The project is presently in its second year, is proceeding on schedule, and is expected to be completed by October 31, 1969.

Evaluation of alternatives in refuse disposal—Raleigh, North Carolina

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PROJECT TYPE: Study & Investigation GRANT NO. D01–UI–00050

GRANTEE: City of Raleigh, Municipal Building, Raleigh, North Carolina 27601

PROJECT DIRECTOR: Warren J. Mann, Director, Department of Public Works, Room 307
Municipal Building, Raleigh, North Carolina 27601

ESTIMATED TOTAL PROJECT COST:	$125,154
GRANTEE'S SHARE:	$ 41,739
FEDERAL SHARE:	$ 27,805 [01]
(by year of project life)	$ 27,805 [02]
	$ 27,805 [03]

DATE PROJECT STARTED: Jan. 1, 1967 DATE PROJECT ENDS: Dec. 31, 1969

OBJECTIVES: (1) To apply an existing mathematical simulation model to the City's refuse collection system to improve its efficiency. (2) To apply a mathematical model to evaluate alternative landfill sites. (3) To develop methods to maximize salvage benefits by choice of disposal method.

PROCEDURES: Staff of North Carolina State University's Departments of Civil, Industrial and Mechanical Engineering will assist the City by conducting the technical studies and evaluations. The simulation model of a refuse collection system developed by Quon, Charnes and Wersan will be applied to the City's refuse collection system to identify cost saving procedures. A mathematical model developed by Wersan will be tested for application to disposal site selection.

A sampling program will be conducted to determine the origin, quantity and composition of the City's solid wastes. The refuse collection system will be analyzed to develop input data for the mathematical model.

A survey of available salvage markets for recoverable waste constituents will be made. The feasibility of separating wastes during collection will be examined.

PROGRESS TO DATE: The following summary of progress is reported by the grantee:

The Public Works Department is designated as the agency responsible for refuse collection and disposal in the City of Raleigh. However, about 40 percent of the total waste disposed of by the community is collected by private contractors. Refuse is collected thrice weekly from over 36,000 dwelling units. Backyard collections of garbage are made twice a week. On Wednesday general refuse in containers or tied bundles is picked up at the curb.

The downtown business district is serviced six nights a week by one load packer. Another packer operates six days a week to service shopping centers.

Commercial and industrial establishments purchase metal box containers that are picked up one to three times a week by two "Dumpmasters" and three "Dempster Dumpster" trucks.

Domestic services are allocated between thirty-five different routes. Fifteen routes are serviced by fifteen load packers carrying one driver and four laborers. The load packer routes are in the more densely populated parts of the city and cover between 1,000 and 1,700 services in a two day period. Twenty routes are covered by two train units. Each unit consists of one "Dumpmaster" with a driver, and five trains each consisting of a scout and three carts staffed by two laborers. The train routes are located in less densely populated parts of the city where set backs are generally in excess of fifty feet. Each train route includes between 350 and 500 services and is covered in one day so that each train covers two routes twice a week.

A preliminary calculation selected at random from among the thirty-five routes suggests that the cost of collection by load packers is $14.82 per ton while collection by train costs $12.18 per ton. No depreciation on equipment is included in these figures.

A study of 60 residences selected according to a statistical model shows that the mean production of garbage per capita is 1.38 lbs per day with an additional production of general refuse of 0.66 lbs per capita per day. The total domestic production of refuse is estimated to be 2.04 lbs per capita per day. The probability distribution for the daily per capita production is logarithmic with a geometric standard deviation of 1.95. Thus 68.28 percent of the individual days will fall between 1.04 and 3.98 lbs per capita per day.

The same study shows that the per service production of refuse is 4.36 lbs per day of garbage and 2.08 lbs per day of general refuse. These figures indicate a total domestic generation of refuse of 6.44 lbs per service per day. The refuse generation per service also follows a logarithmic distribution with a geometric standard deviation of 2.09. Thus the per service generation will range between 3.07 and 13.45 lbs per service per day 68.28 percent of the time.

Care must be taken in the use of the aforementioned figures. The figures for garbage indicate the probable loads for the twice weekly collection. The total figures include the extra collection of general refuse that is made only once a week.

Sixteen cubic yard load packers carried a mean load of 5,910 pounds with a standard deviation of 2,015 pounds for an average density of 370 pounds/cubic yard, plus or minus 126 pounds 68 percent of the time.

Twenty cubic yard dumpmasters carried a mean load of 7,040 pounds with a standard deviation of 2,226 lbs for an average density of 352 pounds/cubic yard plus or minus 111.3 pounds 68 percent of the time.

The Dempster Dumpster boxes averaged 745 lbs plus or minus 451 pounds 68 percent of the time. No attempt was made to compute a density.

The city of Raleigh disposes of refuse in a sanitary landfill located on State property. The site covers about 18 acres of which it is estimated 12 acres have been filled since 1959. In the past decades dating to 1939 a total of six different sites have been utilized. The average need for the past 28 years has been approximately 3.7 acres per year and the average depth of fill has been 11 ft. The landfill is well located adjacent to a major east-west traffic artery, however, it is necessary that a new landfill or alternative method of disposal be selected very soon.

In one measurement it was estimated that 1,544 tons of refuse was accepted in one 6 day week. Nine hundred tons or about 60 percent was collected and delivered by city collection vehicles. An additional 644 tons was collected by Institutions such as N.C. State University, the Dorothea Dix Hospital and private haulers.

Allowing for an estimated 13,523 non residents and 105,722 residents the total daily per capita generation of refuse that is disposed of in the sanitary landfill is 3.7 pounds. Since the domestic generation is 2.04 pounds per capita per day the commercial and industrial contribution may be estimated at 1.66 pounds per day. These figures do not include wrecking of buildings and automobiles.

Analysis of refuse from 60 residences selected according to a random sampling scheme showed the following breakdown:

Category	*Percent by weight*
Combustibles	78.6
Paper	37.6
Food Wastes	31.1
Others	9.9
Noncombustibles	21.4
Metals	7.4
Glass	14.0
Others	Trace

Chemical composition of residential refuse was as follows (all percentages on a dry weight basis unless otherwise noted):

Analysis	*Food wastes*	*Paper and other combustibles*
By weight	31.1%	47.5%
Moisture (by wet weight)	81.7%	25.7%
Ash	14.1%	5.3%
Volatile solids	85.9%	94.7%
Calorific value (Btu/lb)	7,400	7,899
Lipids	9.6%	7.9%
Crude fiber	17.2%	59.2%
Liquids (by wet weight)	85.5%	32.9%
Nitrogen	5.82%	0.5%
Protein	36.4%	3.1%
Carbon	27.85%	----
C/N	4.7/1	55/1
Sulfur	0.15%	----
Potassium (K_2O)	2.5%	0.4%
Phosphorus (P_2O_5)	0.15%	0.015%

Alternatives under study

I. The Collection System. The Wersan model for a collection system has been modified for the IBM 360 Model 75 computer with several improvements based on information gathered in this study. One modification incorporates the actual variability of loads carried by the load packers. A second modification incorporates time study data gathered by Dr. C. A. Anderson. These modifications make the model realistic for Raleigh.

II. Disposal. Landfill. Alternative sites have been suggested by the City Planning Department. More detailed study of the availability and suitability of the sites is underway.

Incineration. Several possible schemes are under examination. One would involve location near the Walnut Creek Sewage Treatment Plant in order to utilize treated sewage as cooling water and digested sludge as a supplementary fuel. Power of the order of 1 or 2 percent of the Raleigh demand could be generated and might be purchased by the local power company.

Salvage. The only salvage markets that have been discovered are for paper and garments. Salvage metal, glass, rubber and plastics introduce problems of quality control in industrial use that apparently militate against the use of this type of scrap.

Compost. It is conceivable that a composting operation in conjunction with the sewage sludge as a source of supplementary nitrogen be an alternative.

County-wide sanitary landfill refuse disposal project

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00053

GRANTEE: Broome County Board of Supervisors, County Office Building, Binghamton, New York 13901

PROJECT DIRECTOR: Roland M. Austin, P.E., Director, Environmental Health Services, Broome County Health Department, 62 Water Street, Binghamton, New York 13901

ESTIMATED TOTAL PROJECT COST:	$42,000
GRANTEE'S SHARE:	$14,000
FEDERAL SHARE: (by year of project life)	$28,000 [01]

DATE PROJECT STARTED: Nov. 1, 1966 **DATE PROJECT ENDS:** Dec. 31, 1967

OBJECTIVES: To provide the Broome County Board of Supervisors with basic information and recommendations pertinent to the selection of a solid waste disposal system which will best meet the needs of the county.

PROCEDURES: The study will be conducted by William J. Virgilio, Consulting Engineer, Endicott, New York. The following types of information will be developed:

1. Estimates of present and future quantities of refuse that will originate in the communities throughout the county;

2. Estimates of annual cost of operation of potential sites and cost per ton for handling refuse at the site;

3. Cost analysis for alternate systems to serve the entire county.

Study results will be used to support a public information program leading to implementation of the most feasible disposal system.

PROGRESS TO DATE: The engineering study has been completed. Principal conclusions and recommendations are summarized below:

The present population of Broome County is 222,000 people, producing an estimated 183,000 tons of refuse per year. Projected population by the year 2000 is 354,000 people with a refuse production of 446,000 tons per year. Broome County is an L shaped area, with the major part of its population concentrated at the junction of the two legs, in the city of Binghamton and environs. Of the total amount of refuse produced in the county, 85 percent is generated in the Binghamton area.

The recommended solid waste disposal system consists of three landfills, the largest to be established in the Binghamton area, with smaller landfills near the end of each of the legs of the county. The county should construct and operate these landfills, with financing provided by means of a tax levied for this purpose. The Broome County Health Department should be the regulatory agency in charge of the refuse disposal system. Refuse collection should remain the responsibility of the individual municipalities.

The county has conducted a public information program to acquaint the public with the recommended disposal plan and acquaint it with the need for, and benefits of, a county-wide system.

Refuse crusher

PROJECT TYPE: Demonstration **GRANT NO. D01–UI–00057**

GRANTEE: City of Tacoma, Washington

PROJECT DIRECTOR: Gilbert M. Schuster, P.E., Director, Public Works Department, City of Tacoma, County-City Building, Tacoma, Washington 98402

ESTIMATED TOTAL PROJECT COST: $431,822
GRANTEE'S SHARE: $143,939
FEDERAL SHARE: $105,358 [01]
$132,622 [02]
$ 49,903 [03]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1970

OBJECTIVES: To demonstrate how demolition wastes can be efficiently incorporated into a sanitary landfill by prior treatment through a refuse crusher.

PROCEDURES: The entire Project will be conducted by city personnel. A mechanical crusher or shredder, scales, and a scale house will be purchased and installed at the existing landfill site. A metal wheeled compactor will also be purchased.

The project will be conducted in three phases, each of which will be of approximately six months' duration.

Phase I. The sanitary landfill will operate under controlled conditions, using solid wastes without any demolition material. (Demolition wastes are not now accepted at the landfill.)

Phase II. The sanitary landfill will be operated under controlled conditions with the incorporation of unshredded demolition waste along with the regular municipal refuse.

Phase III. The sanitary landfill will be operated under controlled conditions, with the incorporation of shredded demolition waste along with the regular municipal refuse.

During all phases of the project records of weights and volumes of solid wastes received and incorporated into the sanitary landfill will be maintained. Savings in landfill volume due to shredding of the demolition wastes, and economics of the process will be determined. Evaluation of the feasibility and practicality of the procedures employed will be made by the City's Department of Public Works.

Feasibility and advantages of shredding other types of solid wastes prior to incorporation into the landfill will also be explored.

PROGRESS TO DATE: The first six months of this project have been devoted to preliminary planning. After considering various types of steel wheeled compactors the city purchased the Rex-Trashmaster. This equipment was delivered to the site late in December 1967.

Bids for construction and installation of scales at the site were received, but all failed to meet the specifications and were rejected. New bids will be called for in February 1968.

The project staff has been reviewing various different types of crushers and expects to call for bids on this item in late Spring 1968.

Des Moines Metropolitan Area solid waste study and investigation

PROJECT TYPE: Study & Investigation **GRANT NO. D01-UI-00060**

GRANTEE: City of Des Moines, Iowa

PROJECT DIRECTOR: Leo L. Johnson, P.E., Director of Public Services, City Hall, Des Moines, Iowa 50309

ESTIMATED TOTAL PROJECT COST:	$109,483
GRANTEE'S SHARE:	$ 36,494
FEDERAL SHARE: (by year of project life)	$ 72,989 [01]

DATE PROJECT STARTED: April 1, 1967 **DATE PROJECT ENDS:** March 31, 1968

OBJECTIVES: To make a comprehensive and detailed analysis of present solid waste collection and disposal operations in the Des Moines metropolitan area, and to develop recommendations for the best regional system for solid waste collection and disposal.

PROCEDURES: The consulting engineering firms of Henningson, Durham and Richardson, Omaha, Nebraska, and Veenstra and Kimm, Des Moines, Iowa, will conduct the study, which will include the following: (1) An analysis of the quantities and nature of solid wastes generated in the study area. (2) Determination of present solid waste collection and disposal practices, and costs. (3) Recommendations for regional solid waste collection practices and cost estimates. (4) Investigation of possible disposal methods and recommendations of the preferable method or methods of disposal. (5) A thorough investigation of existing laws regulating solid waste collection and disposal in the study area, and a recommendation for and formulation of laws needed to implement recommended collection and disposal procedures. (6) An analysis of existing administrative procedures and recommendation of a system for administering the proposed solid waste program. (7) Recommendations for the best means of financing both the capital and operating costs of the proposed programs.

PROGRESS TO DATE: All field work has been completed. The consultants are presently analyzing the data and other information obtained for preparation of the final report.

Each of the six major landfills in the metropolitan area was monitored for one week. Records were kept of the number of arriving trucks, type of hauler, type of vehicle, time, type, volume and origin of refuse. A portion of each of the different types of trucks was weighed so that refuse densities could be estimated. Approximately 14,000 loads of refuse were monitored during this field study.

Questionnaires were sent to the larger industries to develop information concerning the types and quantities of solid wastes produced, and disposal methods. About 90 percent of the questionnaires were completed and returned. Visits were made to many of these industries. City hospitals were visited to determine their solid waste disposal practices. Problems associated with the collection and disposal of abandoned automobiles were examined.

Collection routes have been examined in detail. Many of the routes have already been revised. The consultants have recommended that the city adopt the incentive collection system.

The problem of the disposal of elm trees killed by Dutch Elm Disease has been investigated. The most promising use of this waste appears to be its processing into chips. However, equipment and transportation costs may make this uneconomical.

The consultants are investigating legislative and administrative requirements pertinent to the formation of a metropolitan solid waste collection and disposal agency.

Investigate and evaluate feasibility of refuse baling as a means of conserving sanitary fill space

PROJECT TYPE: Study & Investigation **GRANT NO. D01–UI–00061**

GRANTEE: Public Works Department, City of San Diego, City Administration Building, San Diego, California 92101

PROJECT DIRECTOR: Eric Quartly, Public Works Director, City of San Diego, City Administration Building, San Diego, California 92101

ESTIMATED TOTAL PROJECT COST:	$90,900
GRANTEE'S SHARE:	$30,300
FEDERAL SHARE: (by year of project life)	$60,600 [01]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To investigate and analyze refuse baling in comparison with the City's present Sanitary Landfill Conservation Methods to determine the relative efficiency and economics of refuse baling as a means of extending the life of sanitary landfill sites and reducing the haul distance of refuse collection vehicles. To determine whether the construction of a pilot baling station as a demonstration project is feasible.

PROCEDURES: The City's technical staff will carry out the project as follows: (1) Contact national and international baling companies to determine the variety and capabilities of the equipment available or adaptable for baling of refuse. (2) Obtain suitable balers from local businesses and conduct initial tests evaluating the various refuse baler equipment available to determine which is most suitable for use in pilot operations. (3) Compile data on costs and the compaction achieved with the present sanitary landfill operations as the basis for evaluating the potential economic feasibility of refuse baling. (4) Evaluate the economics of baling/transfer station operation versus a direct haul operation with baling at the final site. (5) Prepare preliminary plans and cost analysis for construction of a pilot refuse baling facility, if this process appears feasible and economical.

PROGRESS TO DATE: The project is well ahead of schedule and it is anticipated that the final report will be ready by April, 1968. The following summary of progress is based on monthly interim reports prepared by the City.

Methods of refuse baling. Letters of inquiry were sent to 50 baler manufacturers, four of which were found to be good prospects in that they plan to or have already started to engineer and construct balers specifically designed for use with municipal refuse. This equipment is being investigated by the City.

A baler test program was conducted by the City from December 11, 1967 to January 19, 1968. Objectives of this program were: (1) to investigate the mechanical feasibility of baling refuse; (2) to compare the compaction obtainable by baling with that obtained by conventional landfill methods; and (3) to determine what problems might be encountered with the disposal of completed bales in a simulated landfill situation.

During a 16-day period a crew of four men, using a local baler leased for the purpose, processed 48.5 tons of typical city-collected refuse into 162 bales averaging 599 lbs apiece in weight and 689 pounds per cubic yard in density. The bales ranged in weight from 335 to 900 pounds, in volume from 0.3 to 1.4 cubic yards, and in density from 370 to 905 pounds per cubic yard.

Certain characteristics of the bales were evaluated by a member of the project staff. "Shape of bales" and "fines retention" were judged to be fair to good, and "handling ease", "liquid retention", and "odor absence" were rated good to excellent.

Sixty-four additional bales, totalling approximately 55 cubic yards, were produced and four placed by means of a fork lift into a space excavated specifically for this purpose, and covered with earth. Approximately 63 cubic yards of space were required to accommodate the bales. Voids between the bales were estimated as being 15 percent of the aggregate bale volumes. These voids resulted from the impossibility of nesting the bales as close together as desired, partly because of their somewhat uneven surfaces, and partly because the fork lift is apparently not an ideal device for this purpose.

A baling demonstration was observed at the American Baler Company's Bellevue, Ohio, plant. Municipal refuse which had been transported from Louisville, Kentucky, in preshredded form and relatively moist condition was processed through a heavy-duty horizontal baler. The four complete bales produced in this demonstration ranged from 1,500 to 2,490 pounds in weight, from 0.92 to 1.56 cubic yards in volume, and from 1,466 to 1,593 pounds to the cubic yard in density. The bales were judged to be excellent in shape with sharp, well-formed corners and relatively smooth surfaces. They appeared to maintain their integrity without appreciable distortion during handling.

As a result of activities to date, the City has reached the following preliminary conclusions:

The local testing program and the Bellevue demonstration tended to supplement and reinforce each other. The balers used in each case were of the same basic horizontal design which lends itself to more continuous, higher production operation than other types. Although the San Diego test baler was light-duty and somewhat antiquated, it successfully processed ordinary city-collected refuse, even without preshredding, into reasonably well-formed bales which generally maintained their integrity despite rather rough handling during transportation and disposal. An important feature of the local test was that, since it involved a large quantity of materials and extended over a period of time, it established the consistent and sustained feasibility of baling refuse which varies considerably in composition and moisture content from day-to-day and from one collection area to another.

The average compaction obtained in the local test, 689 pounds per cubic yard, was only about half as much as would be required to match the approximately 1,380 pounds per cubic yard obtainable by conventional landfill methods (Table I). Densities exceeding that level were attained at Bellevue with modern, heavy-duty equipment and unquestionably give strong support to the view that baling has great potential for San Diego as a means of conserving landfill space and, for cities which must ship their refuse long distances, as an economical form for such transportation.

Compaction of refuse by present methods. A 14-week study of the compaction being obtained by present landfill methods was conducted at the City's Chollas Sanitary Landfill, for comparison with that obtainable by baling.

The tonnage and volume of solid wastes going into the fill were estimated from results of sampling surveys conducted at the fill site. The study was conducted in three phases. In Phase I a bulldozer was employed for compaction, in Phase II a compactor was used, and in Phase III a bulldozer was again used. Results of this study are shown in Table I.

TABLE I

COMPACTION RESULTS FROM TEST PERIODS AT CHOLLAS SANITARY LANDFILL

Item	*Phase I (Bulldozer) Aug. 14-Sept. 28*	*Phase II (Compactor) Sept. 29-Oct. 26*	*Phase III (Bulldozer) Oct. 27-Nov. 27*
Weight			
Tons of refuse deposited*	32,263.9	17,031.34	19,569.7
Tons of water added	1,382.6	2,014.8	2,350.8
Percentage of water added	4.28	11.83	12.0
Volume			
Cubic yards filled	54,290.2	24,625.5	31,790
Density			
Pounds per cubic yard	1,188.6	1,383.2	1,231.2
Percentage of Phase I	100.0	116.4	103.6
Cubic yards per ton	1.68	1.45	1.62
Percentage of Phase I	100	86.3	96.4

* These total tonnages were determined by adding (1) private tonnages derived from a sampling study, and (2) city tonnages from Sanitation Division records.

Baling transfer stations. Considerable data has been assembled for use in making studies of the economic feasibility and optimum locations for one or more possible baler transfer stations. Preliminary designs and cost estimates are being developed.

Production of refuse. Projections of future total and per capita refuse generation in the City of San Diego through the fiscal year 1984-85 are being developed from predictions of population and data on past and present refuse production derived from Sanitation Division records and from sampling studies made by the project staff.

Life of landfills. Studies are in progress to determine the effective life of existing and available future sanitary landfill sites; together with area, flow, and time schedules to establish dates when new landfills must be utilized and when baling transfer stations might advantageously be constructed.

Development of master plan for solid waste collection and disposal

PROJECT TYPE: Study & Investigation **GRANT NO. D01–UI–00063**

GRANTEE: City of New Orleans

PROJECT DIRECTOR: F. Earl Berry, Superintendent of Sanitation, Room 2W13, City Hall, New Orleans, Louisiana 70112

ESTIMATED TOTAL PROJECT COST:	$117,913
GRANTEE'S SHARE:	$ 39,304
FEDERAL SHARE: (by year of project life)	$ 78,609 [01]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To analyze existing solid waste collection and disposal facilities in the New Orleans Metropolitan Area, and to develop a master plan for an integrated collection and disposal system.

PROCEDURES: The firms of Albert Switzer & Associates, Inc., Baton Rouge, Louisiana, and Greenleaf/Telesca Engineers, Miami, Florida, will provide consulting engineering services. The study will consist of three phases.

Phase 1. Population and economic studies. This will include estimates of present population and future population to the year 1986, and population densities; studies of present and estimated future economic and industrial development, existing and proposed land use, and analysis of other pertinent factors of economic growth in the area.

Phase 2. Master waste collection and disposal plan. This will include studies of existing collection and disposal systems, estimation of quantities and characteristics of solid wastes generated, and estimates of future solid waste production. Costs of operating existing facilities will be obtained. A proposed regional collection and disposal system to serve the area for the next twenty years will be recommended.

Phase 3. Economic and financial studies. Comparative costs of constructing and operating the various facilities studied will be developed. Net revenues available for financing the recommended project will be estimated, as well as additional revenues needed. A proposed rate structure will be developed.

Recommendations will be made in a final report for facilities required and methods to be followed to conduct an efficient and economical integrated solid wastes collection and disposal system.

PROGRESS TO DATE: It is expected that the project will be completed on schedule. This study is being coordinated with that of the West Bank, Jefferson Parish, Louisiana (see abstract for Grant No. D01-U1-00019).

The refuse collection routes within the City of New Orleans are being analyzed. The collection and disposal records for the past three years are being reviewed and summarized. Evaluation and verification of the records are now in progress. Two platform scales have been obtained and have been installed at the City's landfills. The three City incinerators are provided with scales. Scales are provided for the incinerators in several of the adjacent cities. Records are being collected at all of these locations. In addition, those few landfills in the adjacent cities are being monitored to determine the types and quantities of refuse being received.

Population projections have been made for the metropolitan area. An industrial wastes questionnaire has been prepared and will be sent to approximately 2,000 industries within the metropolitan area. Site visits will be made to selected industries. The incinerators and other disposal sites are being evaluated for adequacy. Many of the incinerators have been field tested. Potential disposal sites are being reviewed.

Solid waste disposal study for Oakland County, Michigan, and adjacent communities

PROJECT TYPE: Study & Investigation **GRANT NO.** D01-UI-00068

GRANTEE: Oakland County Board of Supervisors, 1200 North Telegraph Road, Pontiac, Michigan 48053

PROJECT DIRECTOR: Daniel W. Barry, Agent, County Drain Commissioner, 550 South Telegraph Road, Pontiac, Michigan 48053

ESTIMATED TOTAL PROJECT COST:	$125,000
GRANTEE'S SHARE:	$ 42,000
FEDERAL SHARE: (by year of project life)	$ 83,000 [01]

DATE PROJECT STARTED: August 1, 1967 **DATE PROJECT ENDS:** July 31, 1968

OBJECTIVE: To formulate a system of solid waste disposal for Oakland County and nearby communities in other counties that will facilitate the implementation of the regional solid waste disposal plan as established by the Detroit Metropolitan Area Regional Planning Commission.

PROCEDURES: The consulting firm of Jones and Henry, Toledo, Ohio will conduct the study which will include: (1) Information collected from all cities, commercial and industrial concerns, planning groups and private waste collectors concerning the volume, composition, and sources of solid waste within Oakland County and nearby communities in other counties; (2) projection of future solid waste production; (3) investigation of disposal requirements of waste generated in surrounding counties; (4) location of possible sites for incinerators and transfer stations and conduct of preliminary soil tests and surveys of these sites; (5) preparation of preliminary layouts of transfer stations and incinerators and estimation of cost for all future facilities; and (6) preparation of final report, including recommendations for interim solid waste disposal procedures for the County until the complete system is in operation.

PROGRESS TO DATE: The project is now in its fifth month of operation and approximately 25 percent of the study has been completed.

Available data was assembled and additional required data developed concerning the volume, composition and sources of solid waste. The existing solid waste disposal system was identified.

Interviews were held with all disposal authorities and all political subdivisions in the study area to secure estimates of the quantity of residential waste produced. Residential waste production was found to be approximately 2.7 pounds per capita per day.

The composition and quantity of industrial waste generated within the study area was obtained through the use of questionnaires which were sent to all industrial and large commercial operations. Personal interviews were used whenever the questionnaires were not completed and returned by mail.

All of the data is now compiled and is being programmed into computers. The computers will be used to locate load centers, determine transport routes, and size disposal facilities.

The next step in the study will be recommendation of the disposal method and facilities required. Once this has been established, the design plans can be produced and an estimate of costs of construction and operation made.

The project is on schedule and is expected to be completed by August 1, 1968.

Farmington River Valley solid waste disposal study and investigation

PROJECT TYPE: Study & Investigation GRANT NO. D01-UI-00069

GRANTEE: Town of Farmington, Connecticut

PROJECT DIRECTOR: Stephen A. Flis, Town Manager, Town of Farmington, Town Hall,
Unionville, Connecticut 06085

ESTIMATED TOTAL PROJECT COST:	$59,186
GRANTEE'S SHARE:	$21,936
FEDERAL SHARE:	$17,130 [01]
(by year of project life)	$20,120 [02]

DATE PROJECT STARTED: April 1, 1967 DATE PROJECT ENDS: March 31, 1969

OBJECTIVES: To determine how and to what extent a group of towns can provide their householders with a better refuse collection and disposal service at feasible cost through community or group action, as differentiated from each town acting separately.

PROCEDURES: The Towns of Farmington, Avon, Canton, Plainville and Simsbury will work together to secure all facts required to meet the objectives of the study. Consulting engineering services will be provided by the firm of Camp, Dresser and McKee, Boston, Massachusetts.

The project will be carried out in accordance with the following procedural outline: (1) Estimate refuse collection and transportation costs, for different methods and collection frequencies, while providing uniform and better service to the homeowner; (2) determine the location, size and availability of refuse disposal sites that will best serve this group of towns, and possibly contiguous municipalities, if economic considerations so indicate; (3) determine the types and the cost of refuse disposal facilities that will most efficiently serve these towns; (4) evaluate the possibility of employing several disposal methods in the proposed system; (5) develop a training program for personnel operating solid waste services; (6) establish and recommend for adoption uniform refuse handling and storage procedures at the household level; and (7) establish procedures for the disposal of tree trimmings, logs, stumps and bulky objects, including junked cars.

PROGRESS TO DATE: Facts relating to existing collection and disposal services and costs have been compiled for each of the five towns. The quantity and characteristics of all refuse now being handled have been estimated by means of field surveys made during May and August of 1967. Information concerning industrial solid waste production and disposal methods was obtained by use of an industrial questionnaire. This data has been summarized, and estimates of future solid waste generation prepared. Information concerning junked cars has been obtained from several of the towns.

Existing disposal areas and practices have been examined and evaluated. Population densities and major road networks in the five-town region have been delineated. Preliminary investigations of possible sites for a joint disposal facility have been initiated.

Discussions have been held with public officials of contiguous cities and towns to secure information concerning their current and future solid waste disposal practices, and solicit their interest in the study now underway.

Some preliminary conclusions have been reported by the Project Director as follows: (1) Costs of the existing refuse disposal systems are indeed moderate, but with the new stricter State requirements these costs are expected to increase considerably. (2) Refuse generated in non-urban areas should be expected to produce a high percentage of forestry-type products, approximately nearly 20 percent of the total tonnage received. Provisions for separate handling and reduction prior to incorporation in a disposal facility should be provided. (3) Technically, weekly tonnage of refuse received at the five separate disposal facilities could be easily and economically handled at a single facility, if such were available. (4) A regional community facility or a commercial facility capable of the reduction and disposal by sale of scrap of all junked cars, refrigerators, stoves, etc., generated in the capital and central regions of the State of Connecticut is a necessity.

Solid wastes disposal study for Flint and Genesee County Metropolitan Area, Michigan

PROJECT TYPE: Study & Investigation GRANT NO. D01-UI-00070

GRANTEE: Genesee County, Michigan

PROJECT DIRECTOR: Thomas H. Haga, Director-Coordinator, Genesee County Metropolitan Planning Commission, 511 Courthouse, Flint, Michigan 48502

ESTIMATED TOTAL PROJECT COST:	$67,833
GRANTEE'S SHARE:	$26,836
FEDERAL SHARE: (by year of project life)	$40,327 [01] $ 670 [02]

DATE PROJECT STARTED: August 1, 1967 DATE PROJECT ENDS: July 31, 1968

OBJECTIVE: To conduct a thorough solid waste disposal study for the Flint and Genesee County Metropolitan Area, and recommend an Area-wide disposal system.

PROCEDURES: The firm of Consoer, Townsend and Associates in Michigan will provide consulting engineering services.

Data pertaining to existing solid waste collection and disposal practices, and quantities and types of solid wastes generated in the Metropolitan Area will be developed from existing information. Field surveys will be conducted as needed to supplement existing data. Present solid waste disposal needs and projected needs to 1995 will be determined. Recommendations for an Area-wide disposal system will be developed.

PROGRESS TO DATE: The project is now in its ninth month of operation and is approximately 75 percent complete.

The Manufacturer's Association of Flint, representing all industries in the Flint area, has provided the consultants with a detailed breakdown of solid industrial waste produced. This breakdown includes the quantities and compositions of the waste, and the disposal facilities presently used for each type of waste. The Association has also provided the consultants with an estimate of the portion of total solid industrial waste which would be relinquished to the regional disposal system once it is in operation. Available information on the production and disposal of residential solid waste has been collected. This has been supplemented by field studies to provide an analysis of domestic refuse samples collected throughout the City of Flint.

A preliminary report has been prepared by the consultant. However, the grantee has requested additional study and revision of certain sections of the report. All of these additional studies are expected to be completed by the end of February. The final report should be completed by May 1, 1968.

Solid waste collection and disposal study, Harrison County, Mississippi

PROJECT TYPE: Study & Investigation GRANT NO. D01–UI–00072

GRANTEE: Board of Supervisors, Harrison County, Mississippi

PROJECT DIRECTOR: John W. Smith, County Engineer's Office, Courthouse Building, Gulfport, Mississippi 39501

ESTIMATED TOTAL PROJECT COST: $50,000
GRANTEE'S SHARE: $16,667
FEDERAL SHARE: $33,333 [01]
(by year of project life)

DATE PROJECT STARTED: June 1, 1967 DATE PROJECT ENDS: May 31, 1968

OBJECTIVES: To make a comprehensive study of solid waste collection and disposal practices within Harrison County, Mississippi, and to develop a 20-year plan for collection and disposal practices within the area. To integrate the present separate solid waste collection and disposal facilities of the individual municipalities into an overall county system.

PROCEDURES: The firm of Albert Switzer & Associates, Inc., Baton Rouge, Louisiana, will provide consulting engineering services required for the project. The study will be conducted in three phases.

Phase 1. Population and economic studies. This will include estimates of present population and future population to the year 1986, and population densities; studies of present and estimated future economic and industrial development, existing and proposed land use, and analysis of other pertinent factors of economic growth in the area.

Phase 2. Master waste collection and disposal plan. This will include studies of existing collection and disposal systems, estimation of quantities and characteristics of solid wastes generated, and estimates of future solid waste production. Costs of operating existing facilities will be obtained. A proposed regional collection and disposal system to serve the area for the next twenty years will be recommended.

Phase 3. Economic and financial studies. Comparative costs of constructing and operating the various facilities studied will be developed. Net revenues available for financing the recommended project will be estimated, as well as additional revenues needed. A proposed rate structure will be developed.

Recommendations will be made in a final report for facilities required and methods to be followed to conduct an efficient and economical integrated solid wastes collection and disposal system.

PROGRESS TO DATE: Some delays have been encountered in getting the study underway. It is anticipated that the grantee will request a time extension for the project to somewhere near the end of 1968.

Information concerning solid waste collection and disposal practices for the entire county is being collected and analyzed. Collection routes and equipment are being considered from the standpoint of adequacy and efficiency. A program is being initiated for determining the quantity and characteristics of refuse produced in the county. The adequacy of present disposal areas is being determined.

Since the county is a resort area the large increase in population during the season must be considered in these studies. It is estimated the year-round resident population of 175,000 is increased by 25 percent during resort periods.

Investigate the potential benefits of rail haul as an integral part of waste disposal systems

PROJECT TYPE: Study & Investigation **GRANT NO.** D01–UI–00073

GRANTEE: American Public Works Association, 1313 East 60th Street, Chicago, Illinois 60637

PROJECT DIRECTOR: Dr. Karl W. Wolf, Research Associate, American Public Works Association Research Foundation, c/o Museum of Science and Industry, Room C-209, 57th and South Shore Drive, Chicago, Illinois 60637

ESTIMATED TOTAL PROJECT COST:	$424,300
GRANTEE'S SHARE:	$141,433
FEDERAL SHARE:	$178,200 [01]
(by year of project life)	$ 58,867 [02]
	$ 45,800 [03]

DATE PROJECT STARTED: April 1, 1967 **DATE PROJECT ENDS:** March 31, 1970

OBJECTIVES: To make a comprehensive evaluation of the costs and benefits obtainable for the collection, transportation and disposal of solid wastes from urban areas by the use of rail-haul techniques.

PROCEDURES: The project will be conducted in three phases, each of which is expected to take approximately one year to complete. Phase One is concerned with the identification, development and setting up of the rail haul and related solid waste transport and disposal techniques. Phase Two will deal mainly with implementation of the rail-haul waste disposal concept in cooperation with selected communities. Phase Three will consist of a comprehensive evaluation of the concept and techniques as demonstrated under actual operating conditions during phase two.

The project will be conducted by staff of the American Public Works Association, with contractual professional and consulting services of various types being obtained as needed.

PROGRESS TO DATE: Progress is reported by the grantee as follows:

Considerable progress has been achieved in the first phase. The groundwork for the system has been firmly established and a substantial variety of system elements has been examined. As a result, a number of unpromising alternatives have been identified and discarded, and work is being concentrated on several of the most promising system approaches.

The most promising general approach to date involves various combinations of (a) transfer stations in the generating communities, (b) rail transport to remote sites, and (c) disposal by a modified sanitary landfill in carefully prepared sites.

Several basic transfer station designs have been generated and are now being refined to accommodate all the necessary techno-economic as well as environmental health aspects. The transfer stations are developed with capacities ranging from 50 to 1,000 tons per eight-hour shift to meet the differing needs of the many dissimilar communities across the country.

A substantial part of the transfer station analysis involves an intensive investigation of processing which should occur at that point in the system. This includes shredding, mixing and particularly the compaction of refuse into bales. Compaction promises many potential benefits including sanitation, control of bacteriological activity, economy in shipment, choice of material handling equipment, extension of landfill life, and an improved stability of the fill to widen its range of ultimate uses. Laboratory-scale compaction tests thus far have produced excellent results and now a production-scale compaction operation needs to be operated to overcome the dangers of extreme extrapolations.

The rail transport as a system segment has even more important beneficial ramifications than was imagined at the start of the study. Intensive work is underway to exploit these potentials fully. This involves scale of operations, transport distances, rail network analysis, loading and unloading practices, disposal operation scheduling, and the application of unit train and rent-a-train concepts among many other aspects. Findings to date suggest that rail transport could be feasible over distances as short as ten miles to as much as 400 miles. Rail car design is also given some attention in consideration of longer-term system developments.

The study of final disposal methods considered central incineration, composting, sanitary landfill, and disposal at sea. The latter two alternatives currently remain as active and attractive possibilities, particularly with respect to short term developments. The use of active or abandoned coal strip mines ranks high among the surviving candidates for types of attractive disposal sites desired. The study produced two significant and original possibilities in strip mine disposal that had not been mentioned in previous studies or the literature.

In the over all, the work to date suggests that waste-rail-haul holds considerable promise of alleviating urban solid waste disposal problems in the near future. There is a very strong likelihood that large savings in the local collection process of participating communities might result as a byproduct.

Evaluation of the Melt-Zit high temperature incinerator

PROJECT TYPE: Study & Investigation **GRANT NO. D01–UI–00076**

APPLICANT: City of Brockton

PROJECT DIRECTOR: John E. Sullivan, Mayor, City of Brockton, City Hall, Brockton, Massachusetts 02401

ESTIMATED TOTAL PROJECT COST:	$67,700
GRANTEE'S SHARE:	$22,570
FEDERAL SHARE: (by year of project life)	$45,130 [01]

DATE PROJECT STARTED: Nov. 1, 1967 **DATE PROJECT ENDS:** Mar. 31, 1968

OBJECTIVES: To evaluate a high-temperature incineration process.

PROCEDURES: An existing Melt-Zit high temperature incinerator located at Whitman, Massachusetts, will be tested and evaluated. Prior to the tests, the facility will be instrumented, equipped with platform and second stack port, and provide with separate water circuits for slag quenching and gas scrubbing. The incinerator will be operated for two days to train the test crew and establish the full-load rating that could be reliably sustained.

The main test is to be a continuous run of four days, using a mixture of refuse and garbage supplied by the City of Brockton. The incinerator will be charged for the first two days at its rated full load, then for 24 hours at ¾ of rated full load, and then for 24 hours at ½ of rated full load. The fifth day's testing will consist of 8 hours of start and stop operation to evaluate the unit under those conditions.

Operation tests will be performed by Elmer R. Kaiser, Consulting Engineer, Scarsdale, New York, who will also prepare the final report of the study. Wisconsin Chemical and Testing Company of Milwaukee, Wisconsin, will conduct air pollution emission studies. The consulting engineering firm of Fay, Spofford, and Thorndike, Inc., Boston, Massachusetts, will provide general engineering services associated with the testing. The American Design and Development Corporation, Whitman, Massachusetts, will furnish the pilot plant and support related thereto for the tests.

PROGRESS TO DATE: Test parameters have been established and a schedule prepared. Testing is scheduled for mid-March 1968, with a final report to be completed by July 1968.

Problems and solutions in the regional approach to incineration of solid waste

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00078
GRANTEE: Central Wayne County Sanitation Authority
PROJECT DIRECTOR: Virgil L. Eller, Superintendent, Central Wayne County Sanitation Authority, 4901 Inkster Road, Dearborn Heights, Michigan 48125

ESTIMATED TOTAL PROJECT COST:	$98,700
GRANTEE'S SHARE:	$32,900
FEDERAL SHARE: (by year of project life)	$65,800 [01]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** Dec. 31, 1968

OBJECTIVE: To demonstrate the advantages of treating incinerator fly ash slurry, and the resulting savings in costs of water, sanitary sewer maintenance, and general operation.

PROCEDURES: The consulting engineering firm of Pate, Hirn & Bogue, Inc., Detroit, Michigan, will conduct the project in three states: (1) Investigation and evaluation of existing systems, equipment and materials for fly ash slurry treatment, and partial recovery of process water. Concurrently, a detailed study of the quantity and quality of the waste will be made at the existing incineration plant. (2) Preparation of plans and specifications for the proposed fly ash treatment system. Competitive bids will be received; the treatment facility will be constructed and placed in operation. (3) Testing and evaluation of the treatment system. Data on flow, solids, efficiency of solids removal, water saved and the effects on the sanitary sewers will be collected.

PROGRESS TO DATE: The project has been in operation for seven months and is approximately 30 percent complete.

A study of the water system of the existing incineration plans has been made to provide a basis for design. By use of an extensive system of weirs and flow meters, the water entering the plant during the 8-day period, August 17 to 24, 1967, was measured and categorized as to use. Of the approximately 550,000 gallons a day entering the plant, an average of 85 percent was found to be used for the spray nozzles, 12 percent for quench nozzles and the remaining 3 percent for flushing. 56 percent of the total water used for spray and flushing nozzles was found to be lost through evaporation. Average temperature of the discharged fly ash slurry was 155°F and the pH was as low as 2.2.

Using the information obtained during the study as a basis for design, the consultants are preparing plans and specifications for a slurry treatment system. The system will be composed of a rectangular settling basin with mechanical sludge removal equipment. Effluent from the settling basin will be recycled through the plant. Sludge will be hauled to the existing sanitary landfill.

One of the primary objectives during the evaluation period will be to determine the pH values of the treated water and its effect upon the plant. Provisions have been made for the installation of chemical treatment equipment in the system, if necessary, for pH control and coagulation.

Due to administrative delays and the necessity of a thorough evaluation of the treatment system, the project life has been extended to December 1968.

Agricultural benefits and environmental changes resulting from the use of digested sewage sludge on field crops, and development of economic and physical characteristic criteria for use in selecting disposal sites

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00080

GRANTEE: The Metropolitan Sanitary District of Greater Chicago

PROJECT DIRECTOR: Frank E. Dalton, Acting Chief Engineer, The Metropolitan Sanitary District of Greater Chicago, 100 East Erie Street, Chicago, Illinois 60611

ESTIMATED TOTAL PROJECT COST:	$914,000
GRANTEE'S SHARE:	$305,000
FEDERAL SHARE:	$329,000 [01]
(by year of project life)	$138,000 [02]
	$142,000 [03]

DATE PROJECT STARTED: March 1, 1967 **DATE PROJECT ENDS:** Feb. 28, 1970

OBJECTIVES: To determine the agricultural benefits and environmental changes resulting from the use of digested sewage sludge on field crops, and to develop the economic and physical characteristic criteria for use in selecting disposal sites.

PROCEDURES: The Agronomy Department of the University of Illinois will conduct laboratory, greenhouse, and field investigations to determine: (1) the most practical amount, frequency, economical method and time for applying digested sludge on crop land; (2) the probability of contaminating surface water and ground water aquifers with pathogens and molecular organic and inorganic ions; (3) the change in soil physical and chemical characteristics to be expected from frequent heavy applications of digested sludge; and (4) the crops and cropping systems that will provide maximum absorption of certain essential and nonessential elements supplied to the soil by digested sludge applications.

Concurrently with the above, the Harza Engineering Company, Chicago, Illinois, will investigate possible disposal sites for the District's digested sludge, and will recommend the site or sites most suitable for this purpose, and evaluate the routes and means for conveyance of sludge to the selected site or sites.

PROGRESS TO DATE:

I. Agronomy Department, University of Illinois

A site was chosen for the field investigation facility on the N.E. Agronomy Research Center in Will County. Construction of an instrument house has been completed, and installation of lysimeter plots is underway.

As a preliminary kind of study 24 lysimeters, 3 feet in diameter and 38 inches deep located on the agronomy South Farm at Urbana were planted to soybeans and treated with various rates of digested sludge and water. During the growing season as much as 10 inches of sludge was applied in one inch applications at 8-day intervals. Soybeans growing on lysimeters receiving sludge applications showed a marked increase in growth. It appears that the lysimeters which were established in 1940 in galvanized metal containers now have an extraordinarily high concentration of zinc in the soils. Soybeans growing on untreated lysimeters suffered a zinc toxicity, while those treated with sludge were not affected by the high zinc concentration.

The ability of the sludge to support the germination and seedling development of corn and soybeans was investigated. Three sludge fractions were used: The sludge itself; the supernatant (SI) obtained by centrifuging the sludge at 6,000 x g for 15 minutes; and the supernatant (SII) obtained by centrifugation of SI at 20,000 x g for 60 minutes. Results indicate an inhibitory effect of all three fractions on seed germination and seedling development. Additional studies of the SII supernatant indicate the presence of a volatile, ether soluble compound(s) toxic to soybeans only. Since the ashes of SII were nontoxic, it would seem that the toxicity is caused by organic rather than inorganic compounds.

Laboratory and greenhouse studies have been initiated with the object of obtaining information concerning the fertility value of digested sludge, amounts of supplemental potassium fertilization required for high yields of corn and soybeans on sludge treated land, the accumulation in soils of heavy elements due to sludge applications, and methods of reducing nitrate accumulations in soil drainage water.

The above indicates in a general way some of the kinds of studies underway. Many of the studies will yield valuable information in directing the future investigative effort.

II. Harza Engineering Company

A summary report on site and route selection studies has been completed. A staged program of land reclamation by use of digested sludge is recommended, which includes the following:

Phase 1. Initiation of a sludge utilization experimental program for late 1967, on a small plot at the West-Southwest Plant.

Phase 2. Acquisition immediately of a 1700-acre site in South-Cook County, south of Tinley Park, on which operations would be initiated in 1968. Sludge utilization at this site would increase from about 30 tons of dry solids per day in 1968 to 220 tons per day in 1971.

Phase 2C. Development during the period 1968 through 1971 of cooperative sites with other organizations, for purposes of demonstrating benefits and possibly obtaining substantial areas for sludge utilization in future years.

Phase 3. Acquisition of a 21,500-acre site at Essex, south of the Kankakee River. This site would be designed to utilize beneficially the forecasted sludge production of the Sanitary District in the year 2015. The Essex site is composed of sandy soils which now have limited agricultural production. Sludge would be applied, which with supplemental irrigation, would raise crop production and agricultural income by about $580,000 per year.

Illinois auto salvage waste pollution control

PROJECT TYPE: Study & Investigation **GRANT NO. D01–UI–00081**

GRANTEE: Illinois Auto Salvage Dealers Association

PROJECT DIRECTOR: Larry Goddard, Executive Director, Illinois Auto Salvage Dealers Association, 631 West Monroe Street, Springfield, Illinois 62704

ESTIMATED TOTAL PROJECT COST:	$40,820
GRANTEE'S SHARE:	$13,820
FEDERAL SHARE: (by year of project life)	$27,000 [01]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To develop guidelines for the collection, handling, storage and processing of abandoned automobiles to serve as the basis of a solid waste disposal program for Illinois Auto Salvage Dealers, so as to improve current disposal practices, eliminate existing health and welfare problems resulting from current practices, and prevent similar problems from developing in the future.

PROCEDURES: The consulting engineering firm of Crawford, Murphy and Tilly, Inc., Springfield, Illinois, will conduct the study, which will include: (1) Data will be developed concerning the location and distribution of auto salvage dealers in Illinois, their current activities, their immediate and expected future solid wastes handling, procedures and problems. This information will be obtained by field surveys of approximately 40 dealer operations, supplemented by a questionnaire survey of an estimated additional 270 dealer operations. (2) Special surveys of some 10 dealer operations will be conducted to check and analyze critical operations, such as those under surveillance by health, welfare or other public regulatory agencies. (3) A study will be made of solid wastes, combustion, metal shredding and compaction processes and auto-scrap utilization to check the feasibility of processes, handling, storage and disposal practices that are compatible with public interest requirements. (4) An economic study will be prepared, indicating the impact and effect of upgrading the handling, processing, storage and disposal of solid wastes to meet present and future public interest requirements. (5) Guidelines will be prepared for industry standards for the collection, handling, storage, processing and disposal of its wastes to meet public requirements.

PROGRESS TO DATE: Field surveys have been completed and work is progressing on the drafting of guidelines for industry standards. Some preliminary findings and conclusions reported by the grantee are as follows: (1) It appears quite obvious that the market preference for clean scrap will bring about increasing movement to the fragmentizing installations. At the present time these costly plants are taking about 50 percent of the Illinois auto body scrap and with the market preferring a premium of about $10 per ton for this decontaminated scrap over the old baled waste, this rules out the practicality of installing regional body burning plants. The prime purpose of a regional burner would, of course, be to prepare the scrap for baling and bales have poor marketability except in limited areas.

(2) Illinois municipalities are effectively disposing of abandoned vehicles. Their actions follow local ordinances and the Illinois Statutes, providing for removal of the "forgotten" vehicle from both public and private property.

Only in their efforts to facilitate the flow of auto scrap have municipalities lagged somewhat. Continuous adjustment takes place between the salvage dealer and the city. Frequent insistence by the city that the salvage dealer pick up these abandoned vehicles is accompanied by the city's efforts to relocate the dealer outside the corporate limits. The dependence of the municipality upon auto salvage dealers illustrated in the study of municipal disposal costs is too often overlooked.

The gross municipal costs of handling abandoned vehicles varies from $27.56 per vehicle where the city handles all processing to $3.73 per vehicle where a local salvage dealer is authorized to handle the processing. Any such municipal costs represent time and equipment taken from security, public works, and public health duties and should obviously be held to a minimum.

(3) It seems that there is a great necessity for an educational program through a comprehensive public relations project to educate the public, the auto salvage dealers themselves, and public officials of the changes in operation and legislation needed to cope with new concepts which must be initiated to assure feasible solutions to the problem.

Based on project findings to date, and with the cooperation of the Governor's office, the Auto Salvage Dealers Association is sponsoring a conference "Our Junked Car Dilemma, Pollution, and Waste Disposal Control," which is to be held in Springfield, Illinois, in March 1968. The purpose of the conference is to focus public attention on the problems concerned and bring together a cross section of industry and government leaders who are directly involved with the auto salvage waste control problem.

Control of dust in handling of solid wastes

PROJECT TYPE: Study & Investigation **GRANT NO.** D01–UI–00082

GRANTEE: Southeastern Oakland County Incinerator Authority

PROJECT DIRECTOR: Allan J. Kronbach, Assistant General Manager, P.O. Box 1248, Berkley, Michigan 48072

ESTIMATED TOTAL PROJECT COST:	$40,000
GRANTEE'S SHARE:	$13,333
FEDERAL SHARE: (by year of project life)	$26,667 [01]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To evaluate the feasibility and economic practicability of controlling the spread of dust into the atmosphere within the incinerator building and outside environment during the handling of solid waste material for disposal.

PROCEDURES: The consulting engineering services will be furnished by the firm of Black and Veatch, of Michigan. The consultant will (1) determine the volume, flow pattern, velocity, and dust content of the air within the incinerator complex; (2) select a system of fans and intake ducts that will produce the most economical reduction of dust loading; and (3) prepare plans and specifications for the implementation of the recommended system.

PROGRESS TO DATE: The project has been in operation for seven months and is approximately 70 percent complete.

The consultants have developed plans for three alternate systems of dust control. The main component common to all three proposed systems is a ring of high velocity air intake ports around the storage pit. Differences in the systems arise from differing location of the low velocity air intake ports within the plant, as follows: (1) above the storage pit; (2) above the charging floor; and (3) in the ceiling of the unloading area. Expected reduction in dust loadings varies from 70 percent to 90 percent depending upon the system involved. Normal atmospheric pressures will be maintained at all times throughout the building.

The Authority is currently considering the proposed systems and will select one for installation at the incineration plant.

The project is on schedule and is expected to be completed by April 1, 1968.

Western Jefferson County solid waste disposal study

PROJECT TYPE: Study & Investigation **GRANT NO.** D01–UI–00084

GRANTEE: City of Lake Mills, Lake Mills, Wisconsin 53551

PROJECT DIRECTOR: Bruce O. Frudden, P.E., Mead and Hunt, Inc., P. O. Box 5247, Madison, Wisconsin 53705

ESTIMATED TOTAL PROJECT COST:	$6,500
GRANTEE'S SHARE:	$2,167
FEDERAL SHARE: (by year of project life)	$4,333 [01]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To determine the feasibility of a joint solid waste disposal system for the communities of Fort Atkinson, Jefferson, Lake Mills, Waterloo, Johnson Creek, and the surrounding rural townships.

PROCEDURES: The entire study will be performed by the consulting firm of Mead and Hunt, Inc., Madison, Wisconsin. The scope of the study will include consideration of the following items: (1) population and projected increase; (2) type and quantity of refuse and projected increase; (3) present collection methods, frequency of pick-ups, equipment, personnel and costs; (4) review of available methods of disposal including landfill, incineration, garbage grinding and digestion, milling and others; (5) analysis of refuse disposal projects that appear feasible for the area being studied; (6) cost estimates for each type of project analyzed, including capital expenditure and annual operating costs; (7) conclusions and recommendations. Consideration will be given to the establishment of a utility to operate a solid waste disposal system for the subject communities.

PROGRESS TO DATE: Field investigations have been completed, all necessary data collected, and the final report is being prepared. At this time, it appears that the major conclusions of the feasibility study will be as follows: (1) A sanitary landfill disposal operation, centrally located and jointly owned by the five communities, will be the most economical system. (2) A jointly owned collection system of container trains, used in conjunction with transfer packer trucks, will be the most economical of the collection systems investigated. (3) The annual cost of the proposed jointly-owned collection and disposal system will be approximately $132,000 or $6.33 per capita. If the surrounding ten townships are included as customers, the communities' share of the annual cost will be $109,000 or $5.22 per capita. The initial cost of the system will be $346,100 or $472,800 if the surrounding townships are included. (4) The community of Waterloo should be included in the joint system. (5) The recommended action is that the five communities jointly operate a sanitary landfill and also jointly operate a container train system of collection vehicles in conjunction with transfer packer trucks. The townships should be approached as potential customers.

Tocks Island regional-interstate solid waste management study

PROJECT TYPE: Study & Investigation GRANT NO. D01–UI–00087

GRANTEE: *Tocks Island Regional Advisory Council

PROJECT DIRECTOR: Frank W. Dressler, Executive Director, Tocks Island Regional Advisory Council, 612 Monroe Street, Stroudsburg, Pennsylvania 18360

ESTIMATED TOTAL PROJECT COST:	$192,000
GRANTEE'S SHARE:	$ 64,000
FEDERAL SHARE:	$ 56,340 [01]
(by year of project life)	$ 71,660 [02]

DATE PROJECT STARTED: June 1, 1967 DATE PROJECT ENDS: May 31, 1969

OBJECTIVES: (1) To demonstrate regional interagency solid waste planning under the leadership of a new type of regional agency consisting of representatives from the six member counties in the tri-state region affected by the Delaware Water Gap National Recreation Area. (2) To develop needed information and plans for optimum solid waste management facilities for the interstate region influenced by the Delaware Water Gap National Recreation Area. (3) To explore and demonstrate the feasibility of resolving a solid waste disposal problem on a regional basis through interlocal and/or interlocal, interstate cooperation and action.

PROCEDURES: In general, the study will involve the participation of representatives of all Federal, interstate, State and local governmental agencies and civic groups which have basic responsibilities for or major interests in the management of solid wastes and the general protection of the environmental health of the area expected to be influenced by the development of the Delaware Water Gap National Recreation Area. The council will establish and utilize three committees—a steering committee, a technical advisory committee, and a solid waste management committee—each composed of one or more members of each of the participating agencies, to assure the successful execution and eventual implementation of the recommendations of the study.

The council will retain the firm of Candeub, Fleissig and Associates, Newark, New Jersey, to provide the necessary consulting services. The study will be carried out through a combination of council staff and consultant activities, supplemented with information and studies to be provided by participating agencies.

The specific work program will consist of the elements which follow.

Determination of the magnitude of the problem. This will consist of an overall look at the entire problem in the study area including such items as identification of geographic sub-areas in the region, study of the characteristics of solid waste and elements involved in its disposal, present and future distribution of solid waste generators in the area, amount of solid waste expected from the National Park, and many other pertinent considerations. From this information, conclusions will be drawn as to the overall magnitude of the problem to be faced in the future, and a series of objectives developed for the present study.

Study design. This will include the development of a detailed prospectus and procedure for undertaking the entire study.

Research and analysis. Present solid waste disposal methods and practices in the area will be defined, together with an indication of their adequacy or of any existing problems. Present practices which appear applicable to the region will be identified, including costs, advantages and disadvantages. Existing legislation applicable to the solid waste problem in the region will be reviewed in each of the States. This will relate to the powers of the States, counties and municipalities to undertake and regulate solid waste activities. The effect of solid waste disposal practices on air, sewer, and water pollution and facilities will be considered.

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* This is an organization of representatives (principally the top elected officials) from the six member counties in the tri-state region affected by the Delaware Water Gap National Recreation Area. The six counties included in this region are: Monroe, Northampton, and Pike in Pennsylvania; Orange in New York; Sussex and Warren in New Jersey.

Possible formulation of solid waste "model". The feasibility of developing a mathematical model which will formalize the relationships which exist between the production of solid wastes and their eventual disposal will be investigated. Alternate possibilities for meeting the present and future solid waste needs of the area will be developed. In the event that it does not prove feasible to develop a satisfactory model then the factors involved will be evaluated by the council staff, consultant, and technical committee, and alternate possibilities developed based on this evaluation.

Development of solid waste plans. Alternate solid waste disposal plans will be developed for serving the area at the present time, by 1975 and by 1990. These will be reviewed by TIRAC, the various committees and other agencies involved. Those plans which appear most appropriate in terms of effectiveness, cost and acceptability to the region will be identified.

Program for implementation. A program for implementation will be developed indicating the necessary steps for immediate action needed to carry out the plans selected.

PROGRESS TO DATE: The consultant has recently completed a report titled "Determination of the Magnitude of the Problem," in which general aspects of solid waste production and disposal in the study area are considered, and sub-areas for study purposes are proposed.

Principal conclusions of the report are: (1) Decisions regarding any of the numerous processes of projecting solid waste generation, collecting refuse, hauling refuse or disposal of refuse require a systems approach. (2) A regional approach for the Tocks Island Region is necessary because most of the Region's municipalities are unprepared to deal unilaterally with the projected increases in solid wastes, interjurisdictional cooperation is needed now and will certainly be required in the future, and all parts of the Region share common problems and characteristics. (3) The study should be conducted in stages, the first stage defining the problem in only its most general terms, and each consecutive stage becoming more detailed as inputs and the state-of-the-art permit.

The report also considers objectives for the study, and presents them in stages as follows:

Initial stage. The first year, during which an approximation of the solid waste system will be attempted and seven alternates tested.

Interim stage(s). During which the types of data will be identified, collection modes, haul trips and disposal methods selected, objectives for the regional system determined, and optimum sub-systems determined.

Final stage. During which alternative systems will be tested, these results analyzed, an ideal system synthesized from those results, and the ideal system tested and programmed for execution.

The Health Department of the three States involved are currently collecting information by questionnaire on quantities and types of solid wastes generated in the area.

A number of public meetings have been held in order to acquaint the area's population of the study which is underway and secure their support.

The project is approximately 20 percent complete and appears to be on schedule. It is anticipated that it will be completed in the time originally specified.

Incinerator water treatment system and Peabody scrubber test

PROJECT TYPE: Demonstration **GRANT NO.** D01-UI-00089

GRANTEE: Whitemarsh Township Authority

PROJECT DIRECTOR: Wayne Seifert, Plant Superintendent, (Incinerator and Sewage), Whitemarsh Township Authority, Township Building, Lafayette Hill, Pennsylvania 19444

ESTIMATED TOTAL PROJECT COST:	$171,000
GRANTEE'S SHARE:	$ 60,350
FEDERAL SHARE:	$ 96,650 [01]
(by year of project life)	$ 12,000 [02]
	$ 12,000 [03]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1970

OBJECTIVES: To test the effectiveness of a proposed waste water treatment system for clarifying and reusing waste water in incinerators and to test the effectiveness of a flooded baffle Peabody scrubber using recirculated treated water.

PROCEDURES: The consulting engineering firms of Abraham Michaels, P.E., Philadelphia, Pennsylvania, and Roy F. Weston, West Chester, Pennsylvania, will provide engineering services in connection with the design, construction and testing of the water treatment plant and the Peabody scrubber.

A waste water handling, treatment, and recirculation system will be constructed at the existing incinerator. This will include the use of chemicals for pH control and precipitation, a clarifier for solids removal, and lagoons for final clarification. The water to be treated is used for gas cooling, siftings sluicing, residue quenching, and the Peabody scrubber.

Tests will be made to evaluate the efficiency of the Peabody scrubber. These will include overall emission quantities for particulates, and gases, such as CO, CO_2, and oxides of sulphur and nitrogen. An effort will be made to test the efficiency of the collector by sampling gases before and after the scrubber.

The efficiency of the several components of the water treatment system will be evaluated by collection of samples of various points in the process and analyses for pH, BOD, and suspended and settleable solids.

City water will be used for the incinerator until 25,000 tons of solid wastes have been incinerated. Following this, effluent from a nearby secondary sewage treatment plant will be used.

PROGRESS TO DATE: Plans and specifications for the water treatment system have been prepared, contracts have been awarded, and construction is about 90 percent complete. It is anticipated that the test program will start by the end of March, 1968.

Study and investigation of solid waste in Appalachian regional demonstration health area

PROJECT TYPE: Study & Investigation **GRANT NO.** D01–UI–00090

GRANTEE: West Virginia State Department of Health

PROJECT DIRECTOR: John H. Miller, Solid Waste Disposal Planning, West Virginia State Department of Health, Charleston, West Virginia 25305

ESTIMATED TOTAL PROJECT COST:	$14,425
GRANTEE'S SHARE:	$ 4,825
FEDERAL SHARE: (by year of project life)	$ 9,600 [01]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** May 31, 1968

OBJECTIVES: To survey and identify present and future quantity and character of solid wastes generated in the region, to study the inter-county approach to solution of solid waste problems involving nine counties in a depressed area and to develop a regional plan for waste disposal, including a forecast of future needs of the region.

PROCEDURES: The study will be conducted by members of the engineering faculty at West Virginia Institute of Technology. Investigations will be conducted to obtain information as to amounts and kinds of solid waste generated in the area and present means of disposal. From these data the area will be divided into waste disposal zones using volume of waste and existing transportation facilities as guides. The disposal problems of each of these zones will be dealt with on an individual basis. At this time any discrepancies or deficiencies in data will be reviewed and corrected. Various meetings with the Southern West Virginia Regional Health Council are planned so that the final report will reflect both the engineering judgment of the study group and the ideas and concerns of the Council.

PROGRESS TO DATE: The project is approximately 70 percent complete. Work commenced on the project June 1, 1967. The survey work for all nine counties has been completed. Planning maps have been prepared designating eleven refuse sheds or regional waste disposal areas. Since most of the population is located along narrow river valleys with villages of less than 1,000 population regional sanitary landfills appear to be the logical disposal method. Various locations for landfills will be analyzed as to haul distances, necessity of transfer stations and economics based upon the population served and the existing collection routes. Where no collection system presently exists, central refuse depository containers or stations may be considered.

Meetings are being scheduled with the Southern West Virginia Appalachian Regional Health Council to introduce prospective recommendations.

The project is on schedule and should be completed by April 30, 1968.

Bulk refuse crusher facility

PROJECT TYPE: Demonstration **GRANT NO.** D01–UI–00091

GRANTEE: City of Buffalo, City Hall, Buffalo, New York 14202

PROJECT DIRECTOR: Leonard S. Wegman, Leonard S. Wegman Co., 101 Park Avenue, New York, New York 10017

ESTIMATED TOTAL PROJECT COST:	$807,600
GRANTEE'S SHARE:	$269,233
FEDERAL SHARE:	$253,467 [01]
(by year of project life)	$261,500 [02]
	$ 23,400 [03]

DATE PROJECT STARTED: June 1, 1967 **DATE PROJECT ENDS:** Dec. 31, 1969

OBJECTIVES: To demonstrate the feasibility of reducing the size of bulky burnable solid wastes by a heavy duty impact crusher to permit disposal by incineration, which would not otherwise be possible because of the limited size of incinerator charging openings.

PROCEDURES: The consulting firm of Leonard S. Wegman Company, New York City, will provide all engineering services associated with construction of the facility, and will furnish necessary services for obtaining operational data, data analysis, and reporting of results.

When the construction has been completed, the City will arrange to collect all oversize solid wastes separately from general garbage and refuse, for processing in the Bulk Refuse Crusher. The crushed bulky wastes will be burned in the existing incinerator. Accurate records will be kept of the quantities, weight and characteristics of material processed. Data as to power consumption costs of maintenance and labor and other costs will be obtained so as to evaluate the economics of the operation.

PROGRESS TO DATE: Construction contracts were awarded by the City in August 1967, and construction is under way. It is expected that installation of the facility should be completed late in 1968, leaving a year for operation and evaluation of the installation.

Economic feasibility of composting refuse and sewage sludge in southeastern Michigan

PROJECT TYPE: Study & Investigation GRANT NO. D01–UI–00092

GRANTEE: City of Riverview, 17700 Fort Street, Riverview, Michigan 48194

PROJECT DIRECTOR: Milton D. Redick, Civil Engineer, Johnson & Anderson, Inc., 2300 Dixie Highway, Pontiac, Michigan 48055

ESTIMATED TOTAL PROJECT COST:	$9,780
GRANTEE'S SHARE:	$3,260
FEDERAL SHARE: (by year of project life)	$6,520 [01]

DATE PROJECT STARTED: June 1, 1967 DATE PROJECT ENDS: Nov. 15, 1967

OBJECTIVE: To evaluate the economic feasibility of constructing a refuse and sewage sludge composting plant in the City of Riverview with particular attention to the market value and quantity of the finished compost and salvaged material.

PROCEDURES: The consulting engineering firm of Johnson and Anderson, Inc., Pontiac, Michigan will direct and conduct the study. The existing marketing channels in the Southern States for refuse compost will be reviewed and evaluated. The present marketing channels for chemical fertilizer in the Michigan area will be surveyed, analyzed, and reported. The methods of bulk shipping, primarily rail and truck, will be investigated. The capital and operating costs for refuse composting plants of various capacities will be developed and reported. The project will be culminated in a written report outlining the results of the survey and conclusions as to the economics of a municipal composting operation.

PROGRESS TO DATE: The final report has been submitted to the Solid Wastes Program for review and approval. The report is expected to be ready for reproduction and distribution by January 1968.

The major conclusions presented in the report are: (1) There now exists a specialized market in the adjacent Michigan–Ohio region capable of absorbing 25,000 tons of compost annually. (2) Total cost of producing the compost in a 300 ton refuse per day plant is estimated at between $8.47 and $9.40 per ton. (3) An estimated income of $6.74 per ton of refuse can be expected from salvaging and from the sale of compost. An additional income of at least $1.00 per ton of refuse can be expected after two or three years of successful plant operation. The net cost of disposal would then be between $0.74 and $1.90 per ton of refuse.

All of the above conclusions are based upon the condition that: (1) contracts can be secured to process the refuse from approximately 190,000 people; and (2) that there is no immediate development of additional compost manufacturing capacity in the region.

The marketing study of the report also includes a discussion of the history of composting within the United States, and the principal reason for success or failure of the different plants.

Demonstration of county-wide solid waste management program and feasibility of sanitary landfill operations utilizing a multi-function machine

PROJECT TYPE: Demonstration GRANT NO. D01-UI-00093

GRANTEE: Niagara County Solid Waste Agency, Court House, Lockport, New York 14094

PROJECT DIRECTOR: William M. Friedman, Jr., Assistant Commissioner for Environmental Health, Niagara County Health Department, 525 Bewley Building, Lockport, New York 14094

ESTIMATED TOTAL PROJECT COST:	$643,069
GRANTEE'S SHARE:	$214,356
FEDERAL SHARE:	$363,017 [01]
(by year of project life)	$ 65,696 [02]

DATE PROJECT STARTED: June 1, 1967 DATE PROJECT ENDS: May 31, 1969

OBJECTIVES: (1) To demonstrate the feasibility and advantages of consolidating and centralizing numerous individual local, public, private, and industrial solid waste disposal operations into a county-wide solid waste management program to be carried out by the Niagara County Solid Waste Agency. (2) To demonstrate the feasibility of operating a sanitary landfill utilizing a newly-developed machine which combines in one unit the operations of trench excavation, refuse compaction and placement in the trench, and provision of a compacted earth cover over the compacted refuse immediately after placement.

PROCEDURES: The Niagara County Solid Waste Agency will purchase two sanitary landfill sites, and with the assistance of an engineering consultant, will prepare detailed plans for the proper development of each. After the sites have been prepared, personnel hired, and all equipment, material, and supplies obtained, the final arrangements will be made for actual operation.

The smaller eastern site (about 25 acres) will be operated as a conventional sanitary landfill during the first year. During this period an economic study will be conducted to determine the feasibility of converting this site to a transfer station. Consideration will also be given to the future provision and operation of an incinerator at this site, with residue disposal either on-site or at the main westerly landfill.

The western, or main site (about 100 acres) will be operated using the D&J Refuse Machine, which is a multi-function unit designed to perform the operations indicated under objective 2 above.

Complete operating records will be maintained at each site. These will include: Quantity and type of waste received; use of equipment including both operating time and down-time; man-hours devoted to the various operations; a complete record of all operating difficulties and operating costs.

Prior to and during the entire operation, adjacent counties and municipalities will be invited to participate. If such cooperative participation appears feasible, due consideration will be given to expanding the membership of the Agency.

Thirteen existing municipal solid waste disposal sites, none of which are operated in a sanitary manner, will be closed and rehabilitated, thus eliminating nuisance conditions.

PROGRESS TO DATE: Project operations have not yet begun, because of delays encountered in the acquisition of suitable landfill sites. The County Solid Waste Agency has the legal authority to purchase sites for solid waste disposal purposes, but has no authority to condemn land for this purpose. Objections of the public to specific sites so far selected has not made it possible for the Agency to purchase them. The necessary steps are being taken to form a Solid Waste District under State law, which would have the required condemnation authority. Upon formation of the District, it is planned to proceed with the project in accordance with developed plans.

It appears at this time that further progress will be delayed until the spring of 1968.

Comprehensive study of solid waste disposal—Cascade County, Montana

PROJECT TYPE: Demonstration GRANT NO. D01–UI–00095

GRANTEE: Board of County Commissioners, County of Cascade, Court House, Great Falls, Montana 59401

PROJECT DIRECTOR: John A. Googins, M.D., Health Officer, City–County Health Department, 1130 17th Avenue South, Great Falls, Montana 59401

ESTIMATED TOTAL PROJECT COST:	$57,000
GRANTEE'S SHARE:	$19,000
FEDERAL SHARE: (by year of project)	$38,000 [01]

DATE PROJECT STARTED: June 1, 1967 DATE PROJECT ENDS: May 31, 1968

OBJECTIVES: To develop a comprehensive plan for the efficient and effective storage, collection, and disposal of solid wastes generated in the County of Cascade.

PROCEDURES: The study will be accomplished through the joint efforts of the County of Cascade, the Cities of Great Falls and Bell, and the towns of Cascade and Neihart. The firm of Thomas, Dean and Hoskins, Inc., Great Falls, Montana, will provide consulting engineering services.

Field surveys will be made and available data collected to provide an inventory of existing solid waste storage facilities and practices, collection equipment and procedures, and final disposal facilities and practices. A program will be formulated for an effective storage, collection and disposal system. The program will be described in a report which will give a complete picture of the problem for the entire county with an integrated plan showing the relation of each community to the total picture. Recommendations will be made as to whether to operate systems for each community, to combine several communities into local area systems, to provide a metropolitan-wide system for Great Falls, or to operate as one county-wide system. Financial studies will be made for operation of both short and long-range programs. A review of legislation will be carried out to determine the status of laws regulating county-wide waste collection-disposal systems. An outline of any required new legislation for the recommended program will be provided.

PROGRESS TO DATE: The study is about 50 percent complete. The consultant, working with various city and county personnel, has collected data and information concerning the various storage collection and disposal techniques in use throughout the county. An inventory of all existing disposal sites throughout the county has been prepared and recommendations as to whether they should be closed or converted to sanitary landfills will be a part of the final plan. Twenty-year population projections are being developed to aid in planning for the county's long-term disposal needs.

Shredding of bulky solid wastes

PROJECT TYPE: Demonstration GRANT NO. D01-UI-00097

GRANTEE: City of New York, Department of Sanitation, 125 Worth Street, New York, New York 10013

PROJECT DIRECTOR: Maurice M. Feldman, P.E., Deputy Commissioner (Engineering & Planning), Department of Sanitation, 125 Worth Street, New York, New York 10013

ESTIMATED TOTAL PROJECT COST:	$2,151,000
GRANTEE'S SHARE:	$1,421,500
FEDERAL SHARE: (by year of project life)	$ 729,500 [01]

DATE PROJECT STARTED: June 1, 1967 DATE PROJECT ENDS: May 31, 1968

OBJECTIVES: To develop, design, construct and evaluate a 975-ton-per-day shearing and shredding facility for reducing bulky solid wastes to a manageable size for efficient disposal in waterfront land recovery, sanitary landfill, and in preparation for incineration.

PROCEDURES: A prototype shearing and shredding installation will be built on a city-owned site adjacent to the Greenpoint Marine Transfer Station. This will include a heavy-duty guillotine type shear for pre-sizing oversized bulky wastes, and a heavy-duty rotary swing-hammer type shredder for further size reduction. Each unit is to be capable of handling an average of 45 tons of bulky wastes per hour.

A consulting engineering firm will be employed to design the proposed installation, provide consulting services in connection with receipt of bids and contract award, and supervise construction.

The ability of the equipment to handle as wide a variety of bulky wastes as can be found in the city will be evaluated. These will range from long timber pilings with concrete caps to softer materials such as rolled carpets. Tests will be conducted to determine production rates, and the reliability of the equipment will be evaluated to determine the percentage of downtime and maintenance required. Operating costs will be evaluated by determining power consumption, manpower requirements for routine operation and other incidental handling costs concerned with feeding wastes to the equipment, the operation of the equipment and discharge of the shredded refuse. These evaluations will involve the Department of Sanitation's engineering staff and a consulting engineering firm which will be retained for this specific purpose.

Disposal of the shredded material will initially be by sanitary landfill. The feasibility of burning the shreddings to generate power for operating the equipment will be evaluated by the city following the above equipment evaluation study.

PROGRESS TO DATE: A contract specifying consulting engineering services required by the city in connection with the design and construction of the project is currently being negotiated with the J. G. White Engineering Corp., New York City. It is anticipated that this will be executed in March 1968, and that the construction contract will be awarded during the winter of 1968.

Dairy manure management methods

PROJECT TYPE: Demonstration
GRANT NO. D01–UI–00102
GRANTEE: Washington State University
PROJECT DIRECTOR: Dr. Donald E. Proctor, Associate Sanitary Engineer, Sanitary Engineering Section, College of Engineering Research Division, Washington State University, Pullman, Washington 99163

ESTIMATED TOTAL PROJECT COST: $546,553
GRANTEE'S SHARE: $182,185
FEDERAL SHARE: $210,127 [01]
(by year of project life) $ 75,676 [02]
$ 78,565 [03]

DATE PROJECT STARTED: June 1, 1967
DATE PROJECT ENDS: May 31, 1970

OBJECTIVES: (1) To demonstrate the advantages of properly scheduled applications of dairy manure to farm lands in areas having seasonally high rainfall and land runoff problems; (2) to demonstrate the use of properly constructed and operated anaerobic lagoons as a feasible method of low-cost storage of dairy manure during seasons unfavorable for land disposal; (3) to compare the relative economic and aesthetic advantages of a water transport system vs a dry system for the collection and disposal of manure; (4) to demonstrate improvements attainable in manure management by providing total roof coverage of confinement areas; and (5) to evaluate the feasibility of using lagoon treatment for dairies without sufficient land for solids disposal.

PROCEDURES: The study will be conducted by a staff consisting of members of the various Departments of Washington State University. Site of the study will be the State Reformatory Honor Farm at Monroe, Washington.

Dairy manure management and disposal will be accomplished in several ways for comparison and demonstration purposes but most emphasis will be placed upon a hydraulic cleaning and lagoon operation method with ultimate disposal on crop lands. A relatively small amount of manure from the dairy herd will be scraped from concrete yards and spread by tank truck and conventional spreaders on farm land. Another small portion will be flushed from the concrete yards and immediately distributed on test plots by a pipe and nozzle system during all seasons of the year.

Most of the manure will be hydraulically flushed into one of two strategically located manure slurry collection sumps and then pumped to a central slurry sump. Here the slurry will be homogenized, sampled, and its volume will be determined. Pre-determined volumes of the slurry will be pumped as desired to one of three anaerobic lagoons, to truck mounted spreader tanks, or through fixed and portable pipes to spreading nozzles for distribution.

For long-term operation at each of three lagoon loading intensities (300, 600, and 800 cubic feet per cow), the effect of loading intensity upon solids destruction, nondegradable solids accumulation, fate of nutrients, supernatant quality characteristics, and fly, odor or appearance characteristics will be demonstrated.

In some instances the anaerobic lagoon supernatant could be disposed of by spray distribution on hay or other crop land. However, during the wetter seasons this could easily result in runoff and pollution problems. Part of this supernatant will be distributed on small test plots during all seasons for demonstration and evaluation. During the wetter seasons, the remainder of the supernatant will be treated aerobically in a system patterned after the activated sludge process.

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The samples of raw manure slurry from the central manure slurry sump, samples of all lagoon effluents, and samples of the aerobic process effluent will be collected daily. Total solids, volatile solids, ash, chlorides, ammonia nitrogen, organic nitrogen, pH and chemical oxygen demand (COD) will be determined daily for these samples. Volumetrically weighted samples will be composited and frozen for weekly determinations of phosphorous, volatile acids, alkalinity and Biochemical Oxygen Demand (BOD). Using these data, a materials balance will be maintained on each lagoon for total solids, volatile solids, ash, chlorides, nitrogen, phosphorus, COD and BOD. The ash and chlorides balances will be used to interpret the significance, if any, of exfiltration and dissolved solids losses from the lagoons.

At approximately monthly intervals, three or more undisturbed stratified sample columns will be collected in each lagoon. These will be sampled at one-foot increments in level to determine the amount of each material remaining in each lagoon. This data, coupled with the running materials accounting for the feed and effluent will allow evaluation of the amount and rate of solids degradation within the lagoons. It will also allow evaluation of the nutrient losses, if any, that occur.

Probably not less than 50 to 70 percent of the manure solids added to the lagoon during the course of a year will remain as non-degraded solids at the end of the year. A very significant fraction of these solids will be in the floating surface crust. When it becomes necessary to totally remove, or perhaps only reduce the accumulated solids residue, the mixing-pumping unit will be adjusted to break up and homogenize the crust and bottom deposits. All, or a portion, of the lagoon contents would then be pumped back to the central manure slurry sump. From there this residual slurry would be repumped to crop lands for ultimate disposal. This lagoon emptying operation would only be scheduled during the summer months when it is least likely that heavy rains could lead to run off and stream pollution. This would also be the period of rapid plant growth so the fertilizer values would be utilized more rapidly. The summer soil temperatures will promote rapid incorporation and stabilization of the biologically resistant organic matter in the slurry removed from the lagoon.

A record will be maintained of the amount, time and method of manure application to all plots of land. Rainfall will be gauged and recorded. To the extent possible, the volume and quality of surface runoff will be detemined for all plots. Well points will be driven in each test plot to sample ground water. Soil profiles and characteristics will be determined in each test plot. The crop productivity of each different plot will be observed and recorded. An attempt will be made to evaluate the effect of each variation of the manure application methods in terms of pollution potential and fertilizer values realized.

In order to evaluate the feasibility of using lagoon treatment for dairies without sufficient land for solids disposal, the draining and dewatering characteristics of the accumulated residual crust and sludge in the lagoons will be observed. Both undisturbed and homogenized lagoon samples will be removed and allowed to drain on screen bottomed test trays. After short-term draining, the cake will be pressed for further reduction of moisture, weight and volume. The character and amount of this solids residue would be estimated to determine the feasibility of trucking such material to satisfactory disposal sites. The press liquor strength will be determined to estimate the amount and degree of treatment that might be needed before, or subsequent to, discharge to municipal sewerage systems.

PROGRESS TO DATE: The first several months of this project have been devoted to construction of facilities at the project site. The laboratory office building and two of the three anaerobic lagoons have been completed. Aerobic treatment facilities are under construction. The cattle confinement area of 65,000 square feet has been roofed.

Information concerning the incidence of mastitis is being developed. Test plot layouts are being prepared.

Demonstration of improved incinerator technology for a small community

PROJECT TYPE: Demonstration GRANT NO. D01–UI–00106

GRANTEE: Shippensburg Sanitary Authority, P.O. Box 129, Shippensburg, Pennsylvania 17257

PROJECT DIRECTOR: Walter K. Smith, Borough Manager, Borough of Shippensburg, P.O. Box 129, Shippensburg, Pennsylvania 17257

ESTIMATED TOTAL PROJECT COST:	$145,013
GRANTEE'S SHARE:	$ 81,671
FEDERAL SHARE:	$136,542 [01]
(by year of project life)	$ 13,400 [02]
	$ 13,400 [03]

DATE PROJECT STARTED: June 1, 1967 DATE PROJECT ENDS: May 31, 1970

OBJECTIVES: To demonstrate that a small mechanically stoked rotary grate incinerator can provide a small municipal area with a feasible means for the disposal of solid wastes, which will meet air pollution standards, eliminate environmental health hazards, and be the most economical method of disposal in an area where sanitary landfill methods cannot be adopted.

PROCEDURES: Consulting engineering services in connection with the design and construction of the incinerator will be provided by the firm of Arrowood, Incorporated, Chambersburg, Pennsylvania.

A stainless steel, perforated rotary grate incinerator will be constructed, consisting of two units, each of which will be capable of handling 36 tons per 24 hours. This facility will be used to dispose of combustible solid wastes from a population of about 12,500 people in the service area around Shippensburg.

Records of incinerator operation will be kept so as to evaluate the performance and feasibility of this type of installation. These will include such items as the amount and characteristics of refuse received, amount of residue produced, time required to incinerate an average load of refuse, capital and operating costs, and any difficulties or problems of operation.

PROGRESS TO DATE: Plans and specifications for the facility have been prepared and bids received. It is anticipated that construction will begin during April, 1968, and the incinerator will be in operation by October, 1968.

Demonstration of the use of model sanitary landfilling methods to convert open dump to recreation area

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PROJECT TYPE: Demonstration GRANT NO. D01–UI–00143

GRANTEE: Department of Sanitary Engineering, Government of the District of Columbia

PROJECT DIRECTOR: Robert R. Perry, Deputy Chief, Division of Sanitation, Department of Sanitary Engineering, Government of the District of Columbia, 14th and E Streets, N.W., Washington, D.C. 20004

ESTIMATED TOTAL PROJECT COST: $1,100,000
GRANTEE'S SHARE: $ 366,667
FEDERAL SHARE: $ 733,333 [01]
(by year of project life)

DATE PROJECT STARTED: Dec. 1, 1967 DATE PROJECT ENDS: Nov. 30, 1968

OBJECTIVES: To demonstrate how open dumping and burning of trash can be eliminated, and the site of the burning and other small tracts of land, within densely populated metropolitan areas, can be reclaimed for recreational use utilizing model sanitary landfill methods.

PROCEDURES: The District of Columbia proposes to discontinue open burning of solid wastes at the Kenilworth site and convert it to a recreational area through the use of model sanitary landfill methods.

Consulting engineering services will be furnished by the firm of Whitman, Requardt and Associates, Baltimore, Maryland. The consulting firm will be responsible for the planning and development of specifications for a model sanitary landfill to permit the ultimate development of the site as planned by the National Park Service and the District of Columbia Department of Recreation, and will also provide engineering inspection services to assure that the plans and specifications are followed in detail.

A contract is contemplated for the actual operation of the sanitary landfill with a firm having national recognition and experience in the operation of model sanitary landfills. The sanitary landfill operator will be responsible for obtaining the necessary equipment and operating the landfill in accordance with the approved engineering specifications.

Lands to be used for the sanitary landfills will be made available by the National Capital Parks. The ultimate use plans will be developed by the National Park Service and the District's Department of Recreation. As the landfilling is completed, the National Park Service will develop the Kenilworth Park site facilities.

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service
Environmental Control Administration

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solid wastes program
regional offices

REGION I
John Fitzgerald Kennedy Federal Building
Boston, Massachusetts 02203
(telephone: 617-223-6687)

REGION II
837H Federal Office Building
26 Federal Plaza
New York, New York 10007
(telephone: 212-264-2523)

REGION III
220 Seventh Street, NE
Charlottesville, Virginia 22901
(telephone: 703-296-1445)

REGION IV
404 Peachtree-Seventh Building
50 Seventh Street, NE
Atlanta, Georgia 30323
(telephone: 404-526-3454)

REGION V
712 New Post Office Building
433 West Van Buren Street
Chicago, Illinois 60607
(telephone: 312-353-5465)

REGION VI
Federal Office Building
601 East 12th Street
Kansas City, Missouri 64106
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REGION VII
1114 Commerce Street
Dallas, Texas 75202
(telephone: 214-749-2007)

REGION VIII
9017 Federal Office Building
19th and Stout Streets
Denver, Colorado 80202
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REGION IX
254 Federal Office Building
50 Fulton Street
San Francisco, California 94102
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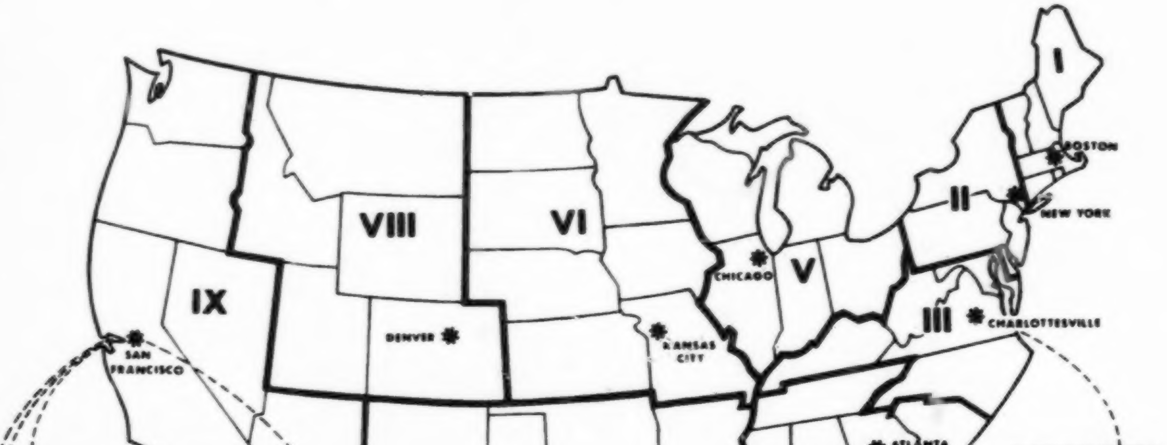
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